

# ELECTRICAL CONSTRUCTION AND MAINTENANCE

AUGUST • 1950

*49th Year*

## **Interference**

*How to handle problems of radio interference from fluorescents.*

## **Brooklyn-Battery**

*How New York's newest, fluorescent lighted tunnel was electrified.*

## **Records**

*How to develop a compact, coded record system for circuits and equipment.*

*and Featuring*

## **Estimating**

*How to apply the six "operators" to adjust labor units to job conditions.*

A  
McGRAW-HILL  
PUBLICATION

# Save Lighting Dollars!

The BEST in modern lighting calls for the BEST in lighting accessories. These General Electric components provide day-in, day-out operation that spells long-run economy—that saves lighting dollars.



Write  
for  
GEA-897



## M AND D TRANSFORMERS FOR LIGHTING CIRCUITS

Now you can get special lighting transformers at the same price as conventional units! These units, equipped with two 5% rated-kva taps below rated primary voltage, can be used to compensate for a 5% or 10% drop in line voltage, thus providing rated voltage to the lamps. There are 11 sizes from 1 to 50 kva, rated 480 volt primary, 120/240 volt secondary. Ideal for your new lighting job, or if you are not getting full light output from your present system. A complete line of these units with 600 volt primary is also available, at a slightly higher price.



Write  
for  
GEA-5070



## BALLASTS FOR MERCURY-VAPOR LIGHTING

For lighting high-bay areas, mercury-vapor lamps provide both economy and efficiency. General Electric Tulamp ballasts make economical mercury vapor lighting cost even less. This popular Tulamp unit powers two lamps at high power factor, giving steady, abundant light. It costs less than two single-lamp units, cuts installation and operating costs. There's a complete line of G-E mercury-vapor lamp ballasts to meet virtually any installation requirement.



Write  
for  
GEA-4950



## BALLASTS FOR FLUORESCENT LAMPS

The heart of a fluorescent fixture is the ballast. The design and construction of the ballast can affect lamp life, lamp light, and the life of the ballast itself. All General Electric ballasts are designed and built to give correct voltage and current for the lamps they operate—to provide rated lamp output and full lamp life. For the most for your lighting dollar, specify G-E ballasts in the fixture you buy. Buy when you see the familiar General Electric ballast tag on a fluorescent fixture. Apparatus Department, General Electric Company, Schenectady 5, N. Y.

GENERAL  ELECTRIC

411-81



# Bring on your weather!

Here's a really waterproof switch!



No corrosion problem. Cabinet is made of a special rust-resistant steel! Melamine, an armor-like finish, is baked-on for positive protection.

Flanged sides of top welded to cabinet.

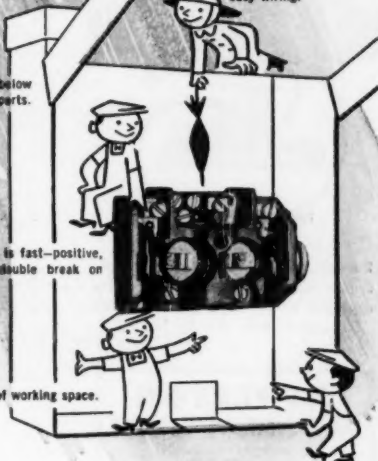
## WEATHERPROOF... Inside and Out

No matter what the weather conditions—rain—snow or ice—you can put up this Murray switch with confidence that it will last! It's weatherproof. Inside and out!

Tight, water-proof seal where switch handle enters.

Solderless connectors for easy wiring.

Knockouts located below current carrying parts.

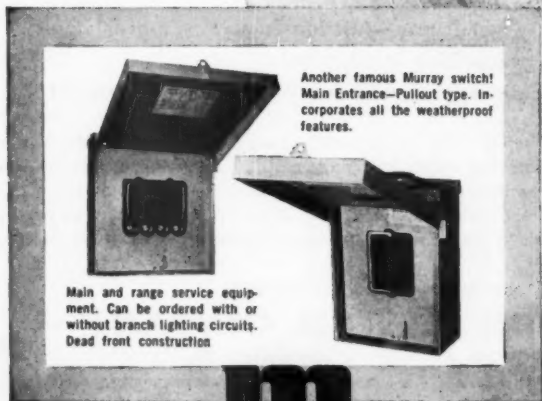


Rotor switch is fast—positive, provides a double break on each pole.

Plenty of working space.

Flanged sides of bottom welded to inside of cabinet.

Rotor housed in porcelain block that quenches arc.



Another famous Murray switch! Main Entrance—Pullout type. Incorporates all the weatherproof features.

Main and range service equipment. Can be ordered with or without branch lighting circuits. Dead front construction.

Listed by Underwriters' Laboratories, Inc.

**Murray**

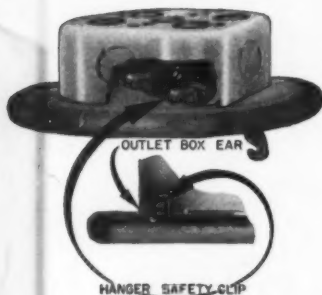
**MANUFACTURING CORPORATION**

1250 ATLANTIC AVENUE • BROOKLYN 16, N. Y.

**Electrical Safety Devices For Home and Industry**

# AT LAST! A Really SAFE Fluorescent Fixture Hanger

## Prevents Injury to Personnel!



Should screws vibrate or rust through, fixture will stay up—supported by exclusive safety clips (arrow) which rest on ears of outlet box.



**Appleton Type "SFH" Fixture Hanger  
For Use with Appleton 4-O or 4-OD Outlet Boxes**

**Costs No More Than Ordinary  
Fixture Hangers—Yet Gives You ...**

- Double Protection Against Falling!
- Sliding hooks to permit instant, permanent alignment!
- Easy installation—Just loosen screws, mount, tighten!
- Better looking installation!
- Quality approved by safety engineers everywhere!

Pear-shaped screw holes permit speedy mounting to outlet box without removing outlet box screws. A 10-degree turn seats hanger in position with hanger clips over outlet box ears. Complete with two five-foot chains, hooks and cord clips—or hanger may be purchased separately. Two-wire receptacle or three-wire twist-lock receptacle.

**SOLD THROUGH ELECTRICAL WHOLESALERS**

**APPLETON ELECTRIC COMPANY**  
**1704 WELLINGTON AVENUE • CHICAGO 13, ILLINOIS**

Branch Offices: NEW YORK, 50 Church St. • DETROIT, 3049 E. Grand Blvd. • CLEVELAND, 1836 Euclid Avenue • SAN FRANCISCO, 655 Minna St. • ST. LOUIS, 227 Frisco Bldg. • LOS ANGELES, 100 N. Santa Fe Avenue • ATLANTA, 724 Boulevard, N.E. • BIRMINGHAM, 429 Brown-Marx Bldg. • MINNEAPOLIS, 305 Fifth St., S. • PITTSBURGH, 414 Bessemer Bldg. • BALTIMORE, 100 East Pleasant St. • BOSTON, 10 High Street • DENVER, 1921 Blake Street • PHILADELPHIA, 1017 Cherry St. • CINCINNATI, 626 Broadway • HOUSTON, 738 M. & M. Bldg. • HAVANA, Cuba, Malecon No. 9.

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**Export Representatives:**

International Standard Electric Corp., 67 Broad St., New York 4, N.Y.



**APPLETON**  
**SAFETY SWIVEL HANGERS**

TYPE  
"SSH"

Patent  
Applied For

Designed to assure adequate support for heavy duty lighting fixtures used in industrial installations. Entire weight of suspended unit is carried by a fixture stud, greatly increasing load capacity of hanger unit.

# APPLETON

CONDUIT FITTINGS • LIGHTING EQUIPMENT • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES

# ELECTRICAL CONSTRUCTION AND MAINTENANCE

Published for electrical contractors, industrial electricians, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

49th Year—AUGUST • 1950

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all  
new  
all  
the  
way  
thru

# Buy One



**MOTOR STARTERS**  
with the

*'Strongbox' Magnet Coil*

All the best features in popular sizes for motors to 50 hp. See for yourself. Get a new General Electric Motor Starter. Get out your screwdriver. And get the facts. Make your own comparison on these big ALL-NEW features:

**STRONGBOX MAGNET COIL**—Coil is locked in a tough block of plastic.

**NEW ARC HOOD**—Molded, burn-resistant arc hood snuffs arc immediately.

**NEW CONTACTS**—Large silver contacts with plenty of contact pressure give long life. Convertible from normally open to normally closed in size one and smaller—without additional parts.

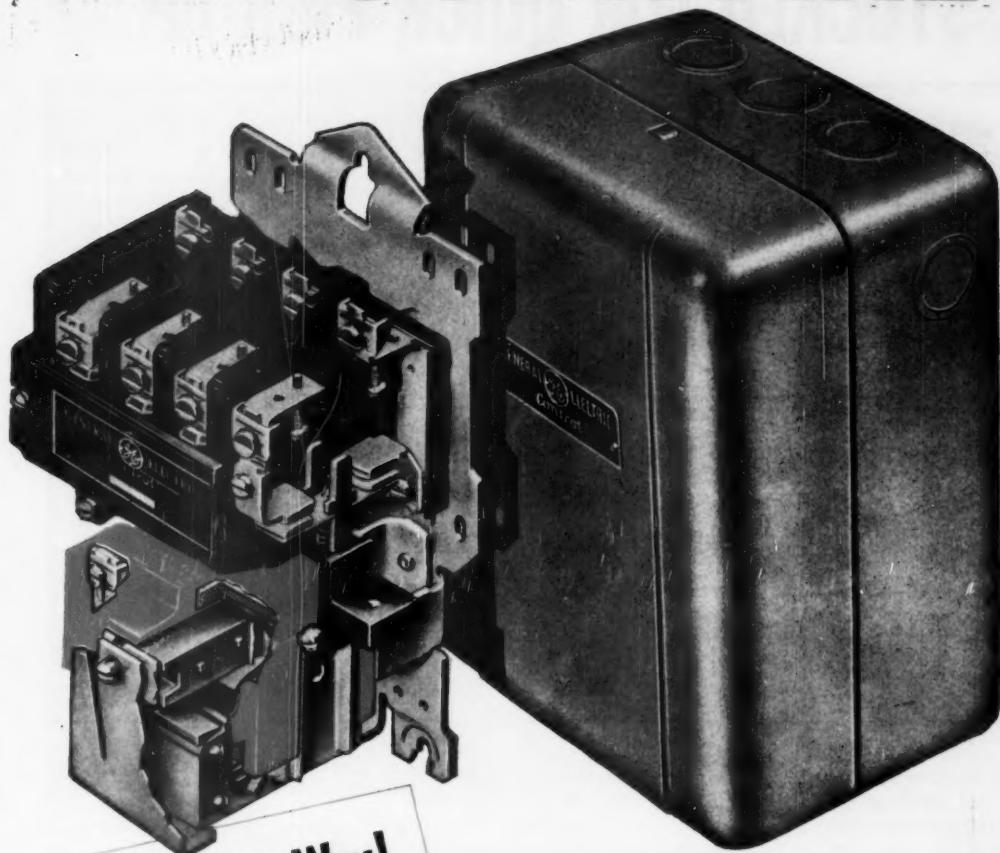
**NEW MAGNET**—Quick direct action, large striking surface.

**EASY TO INSTALL—EASY TO MAINTAIN**—See how easy it is to get at the ALL-NEW General Electric starter. Note, too, that it's built to take the punishment of day-in, day-out use with a minimum of maintenance. Check the wiring space inside the case. Check the terminal clamps that make installation fast. Check the ease with which controls can be inspected.

**DESIGNED FOR FAST ACTION—BUILT FOR LONG LIFE**—From the tough STRONGBOX magnet coil to the high strength arc hood, all parts of the new General Electric Motor Starter are built to last. In the revolutionary G-E design, the plastic coil enclosure also serves to guide the armature. For fast, positive action the tough plastic block is impregnated with a permanent lubricant—molybdenum sulphide. Channel-reinforced magnet guides slide smoothly for quick action at all times. Bimetallic thermal relays give swift protection.

**GENERAL**  **ELECTRIC**

# and COMPARE



**Order this Easy Way!**

Look inside. Make the screwdriver comparison test. Inspect the many new features, and we're sure you'll be enthusiastic. Just fill in the coupon at the right and we'll send you the starter immediately. Or, if you prefer, we'll be glad to send you the new, free, tell-all booklet "Look Inside and Compare" that gives more detailed information.

General Electric Company, Apparatus Department  
Section T676-281, Schenectady 5, N. Y.

Send me one of the NEW CR7006 starters (size 1, 3 pole, enclosed). List Price \$24.20.

☐ Check Enclosed. (Add any state or local sales or use taxes)

☐ Purchase order attached; bill to our account with: \_\_\_\_\_

(Name and address G-E sales office or G-E distributor.)

Motor Horsepower Rating (check one)

☐ 3 ☐ 5 Horsepower at 220 Volts

☐ 3 ☐ 5 ☐ 7½ Horsepower at 440 Volts } 60 Cycles, 3 Phase

Approx. Motor Speed ☐ 1800 RPM ☐ 3600 RPM ☐ 1200 RPM

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

Zone \_\_\_\_\_

State \_\_\_\_\_





# FLOODLIGHTS

for 95% of your jobs

## STOCKED FOR QUICK PICK-UP

### SPORTS AND AREA LIGHTING

Type L-69

1000-1500 watt

Alzak\* processed  
aluminum  
spun-sealed—  
enclosed  
Wide, medium  
or narrow beam



### AREA LIGHTING

TYPE L-45

300-1500 watt

Porcelain  
enamel  
Open—  
Wide beam



*Alzak\* aluminum adaptor available for  
concentrated beam*

### GENERAL PURPOSE

Type L-82 500 watt

Type L-83 1000 watt

Alzak\* processed  
aluminum  
Hinged door—  
enclosed  
Narrow or  
wide beam



### HANDY FLOODLIGHT

Type L-66

200-300 watt

Wide beam—  
aluminum  
Clamp-ring  
door—  
enclosed



### HANDY FLOODLIGHT

Type L-65

100-150 watt

Wide beam—  
aluminum  
Snap-ring  
door—  
enclosed



### LAMP HOLDER

Type L-65-P

Takes 150 watt Par 38

spot or  
projector  
floodlight  
(not furnished)



For 95 per cent of your needs these General Electric floodlights will do the job—and they are immediately available from your G-E distributor's shelves.

For the other 5% of your floodlighting contracts—swimming pools, fountains and similar specialized applications—there are other General Electric floodlights specifically made for the job. Your G-E distributor can give you all details and get you prompt delivery.

All General Electric floodlights are designed for quick installation and easy maintenance. With G-E floodlights installed, you can accept maintenance contracts with confidence.

See your General Electric distributor for the floodlight that's right for your job.

\*Manufactured under Aluminum Company of America Patents.



**YOURS FOR THE ASKING**—This manual contains floodlighting plans for all popular outdoor sports. It's complete—right down to lists of materials. You'll find it a handy reference. Just ask for GET-1284C, Apparatus Department, General Electric Co., Schenectady 5, New York.

# GENERAL ELECTRIC

431-146

# NEW TRUCK MOUNTED CONTACTORS Cut Inspection Time!



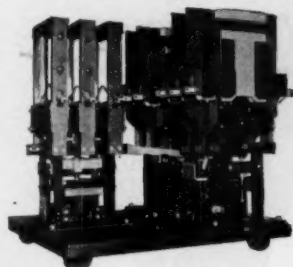
**N**ow, for the first time, air contactors have been truck mounted! The contactors of this Synchronous Motor Controller are mounted on wheels—easy to remove through front or rear hinged doors. Just disconnect the power leads, unplug the control circuits and withdraw the contactors for easy inspection.

You save space! The starter is smaller because room for inspection isn't needed within the cubicle. Truck mounting is a feature of Type H Starters using three air contactors.

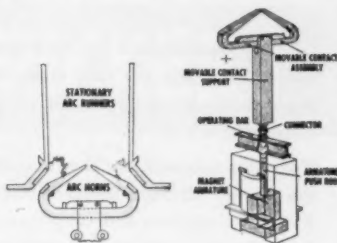
For complete control plus protection of squirrel-cage, synchronous and wound rotor motors up to 1500 hp at 5000 volts . . . all in one attractive steel cabinet that is compact and easy to install . . . specify Allis-Chalmers Type H Starters.

For full or reduced voltage starting, a single starter or an entire control group, check with your nearby A-C representative or send for bulletins 14B6410 and 14B7303.

A-3107  
ALLIS-CHALMERS, 930A SO. 70 ST.  
MILWAUKEE, WIS.



**THREE TYPE 256 AIR-BREAK CONTACTORS** are mounted on a common base of heavy gauge metal . . . mechanically interlocked to provide reversing and dynamic braking for a synchronous motor. Base is on wheels—rolls into cubicle on guide rails. This truck mounting provides for quick, easy, unhindered inspection.



**DOUBLE BREAK CONTACTS AND STRAIGHT LINE VERTICAL ACTION** are combined in Allis-Chalmers Air-Break Contactors to eliminate maintenance factors like flexible contact leads, turning shafts and shaft bearings. These contactors are clean, easy to inspect and maintain . . . accessible in compact, attractive Type H Starters.



## ALLIS-CHALMERS

# You can't buy Better Fittings

or ones that  
cost less  
to use



Quicker to use and neater in appearance, Briegel All-Steel Indenter Fittings not only make stronger connections but also make each job more profitable to the contractor and satisfactory to his customers.

Two Easy Squeezes and they're set to stay. It is only natural that the Briegel All-Steel Indenter Fittings are the most widely used E.M.T. connectors and couplings. Contractors the world over recognize their cost cutting qualities and the fact that they make each wiring job neater, stronger and better.



All B-M Fittings Carry the  
Underwriters Seal of Approval



**BRIEGEL** METHOD  
TOOL  
CO.  
GALVA. • ILLINOIS

#### DISTRIBUTED BY

The M. B. Austin Co., Northbrook, Ill.; Clayton Mark & Co., Evanston, Ill.; Clifton Conduit Co., Jersey City, N. J.; General Electric Co., Bridgeport, Conn.; The Steelduct Co., Youngstown, Ohio; Enamelled Metals, Pittsburgh, Penn.; Kendu Mfg. Co., Ltd., Preston, Ont.

YOU CAN BE **SURE**.. IF IT'S  
**Westinghouse**



## Don't be a **FIXTURE PICKER!**

This "character" looks worried. He's picking lighting fixtures. But he won't find the answer in a magazine cutout.

What's more, there is no single "cure-all" lighting fixture. You know that, of course, but how many others do? Each luminaire has a different purpose—a different application—and a different economy depending on specific conditions.

Analyzing these conditions takes an expert. You need the services of a lighting engineer.

Whether you plan lighting, buy lighting, or install lighting, the services of a Westinghouse Lighting Engineer are available to you. J-04281



**Westinghouse**  
**PLANNED**  
**LIGHTING**  
**PAYS**

# Two NEW Steel City Clamps

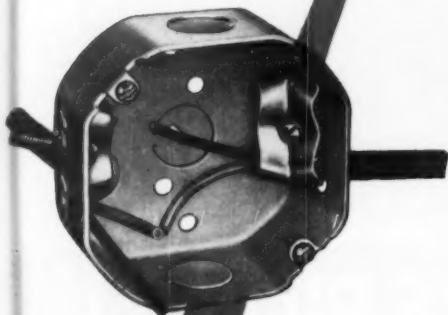


**THE "N" CLAMP**  
For Non-Metallic  
Sheathed Cable  
14-2, 14-3, 12-2, 12-3

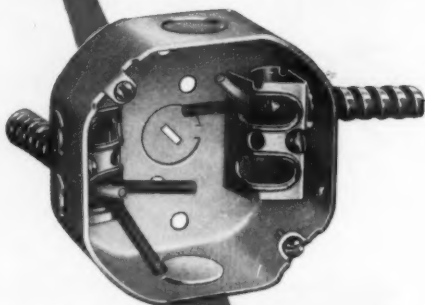
**DESIGNED  
to do better  
jobs and save  
installation  
time**



**THE "A" CLAMP**  
For Armored Cable  
14-2, 14-3, 12-2, 12-3



Whether bottom or side entry, this smoothly rounded clamp can be depressed upon to hold the cable firmly with no possibility of damage to insulation.



Openings are flanged to prevent damage to insulation. Side or bottom entry can be made without backing out screw, and positive, non-slip grip is assured.

Screws in both "N" and "A" clamps are staked to prevent vibrating out of the box in transit.

These clamps will be furnished in the Steel City line of 4" Octagon Clamp Boxes and will be catalogued as follows:

	54151-N	54151-A	
	54151-NS	54151-AS	
"N" for Clamp	54151-NSB	54151-ASB	"A" for Clamp
"S" for Stud	54151-NB	54151-AB	"S" for Stud
"B" for Bar	54151-NE	54151-AE	"B" for Bar
"E" for Ears	54151-NSE	54151-ASE	"E" for Ears

Samples of these clamps can be had upon request

Steel City Leads in

**STEEL CITY**

OUTLET BOXES AND COVERS  
JUNCTION BOXES, CONDUIT FITTINGS AND ELECTRICAL SPECIALTIES



Meeting Your Needs

**ELECTRIC CO.**

SWITCH AND FLOOR BOXES  
JUNCTION BOXES, CONDUIT FITTINGS AND ELECTRICAL SPECIALTIES

PITTSBURGH 33, P.A.





## This is the process of progress...

Look, for example, at what's going on today in the field of insulated wire and cable. Many of the country's most progressive contractors now are using *aluminum* for feeders and other industrial cable installations.



Remember—it took initiative and work for these contractors to hunt down the answers . . . to find *by figuring jobs* that aluminum costs less, weighs less, puts less strain on a building. Result: a payoff in reputation with credit for good jobs at lower prices.

See the reward for this sort of progressive action yourself . . . figure one good feeder installation both ways, in Alcoa Aluminum and in copper!



### NEW QUESTION & ANSWER BOOK

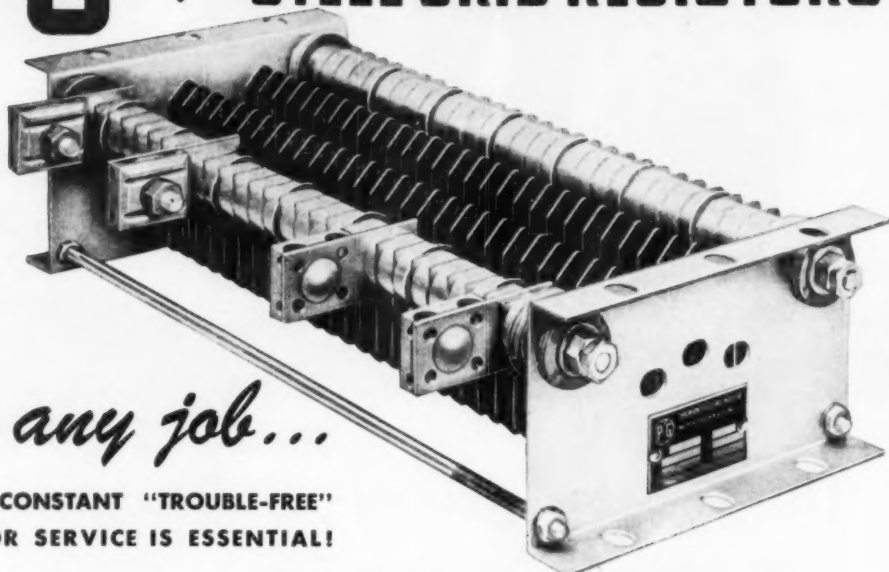
For names of manufacturers and copy of "Questions & Answers about Insulated Aluminum Conductors" phone your nearby Alcoa Sales Office or write ALUMINUM COMPANY OF AMERICA, 1785H Gulf Bldg., Pittsburgh 19, Pa.

**Insulated Aluminum Conductors**  
 of **ALCOA**  **ALUMINUM** are made by leading manufacturers

# P-G

# *Nonbreakable*

# STEEL GRID RESISTORS



*for any job...*

WHERE CONSTANT "TROUBLE-FREE"  
RESISTOR SERVICE IS ESSENTIAL!

P-G "Type T2" Steel Grid Resistors are designed for heavy duty applications in Mines, Steel Mills, Railroad Shops and any other usage where the electrical equipment may be subject to severe service. Built entirely of steel and mica, there is nothing to break. They are sturdy, light in weight and stand up well under occasional overload. Resistance values of P-G Resistors remain remarkably constant, regardless of temperature or age.

*Give us your specifications...*

A P-G engineer can help solve your Resistor problem.

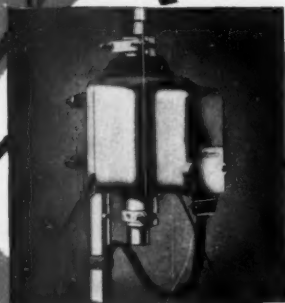


*The Nonbreakable Steel Grid Resistor*

**THE POST-GLOVER ELECTRIC COMPANY**

• ESTABLISHED 1900 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO



The ALLIANCE TENNA-ROTOR rotates the antenna at 1 rpm either clockwise or counter-clockwise through 360° with a positive mechanical stop at end of travel. In the Model DIR (illustrated), sensor in rotator unit operates meter in control box to show direction. Reversible motor in rotator unit operates on 24 volts supplied by transformer in control box through a 3-position switch. Motor leads are insulated and protected by Natvar 400 extruded vinyl tubing.



**alliance**  
TENNA · ROTOR

INSULATED WITH  
**NATVAR 400**

AIMS THE ANTENNA IN  
ALL KINDS OF WEATHER

The TENNA-ROTOR, made by Alliance Manufacturing Company, Alliance, Ohio turns a beam antenna to the compass point where interference is least and reception is best.

It is designed and built to operate for years exposed to rain, snow and sleet. For this rugged service, components are carefully tested and selected. Natvar 400 extruded vinyl tubing is used in the rotator unit for motor leads because of its superior resistance to weather.

Natvar 400 also has uniformly superior resistance to oil, and is approved for continuous operating temperatures of 105°C. Prompt deliveries can be made either from a nearby wholesaler's stock or from our own. Full Underwriters report on request.

**Natvar Products**

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglass cloth
- Silikene coated Fiberglass
- Varnished papers
- Slot insulation
- Varnished tubings and sleeveings
- Varnished identification markers
- Lacquered tubings and sleeveings
- Extruded vinyl tubing and tape
- Extruded vinyl identification markers

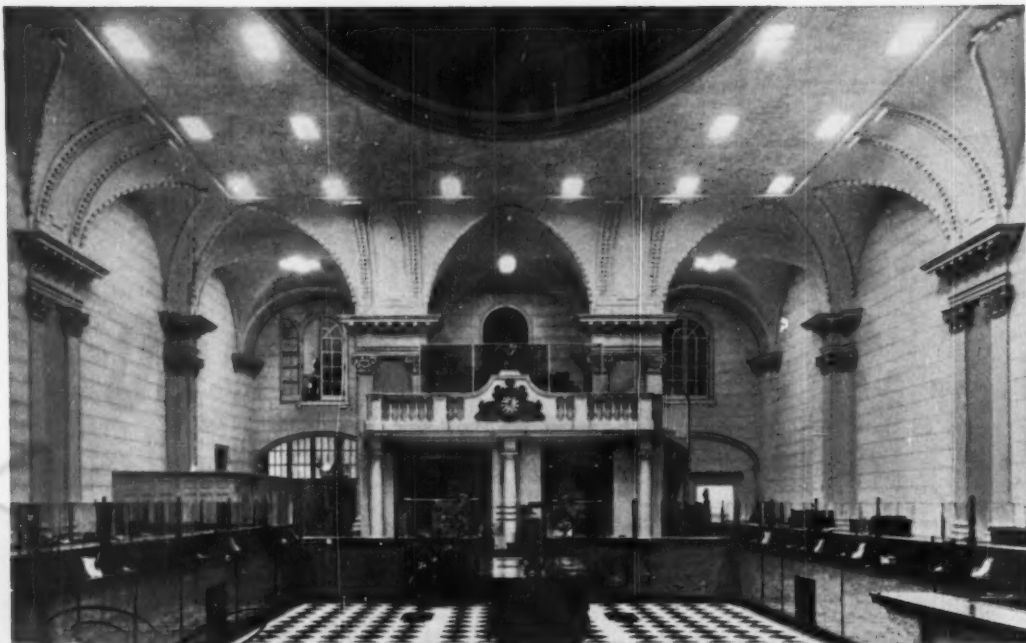
Ask for Catalog No. 21

**THE NATIONAL VARNISHED PRODUCTS Corporation**

Telephone  
Rahway 7-8800

Cable Address  
NATVAR: Rahway, N. J.

205 RANDOLPH AVENUE ★ WOODBRIDGE, NEW JERSEY



## Light on an old banking problem

BRIGHT and friendly is the interior of this bank since it was given new life with properly designed lighting. Though the soaring ceiling presented a problem, Litecontrol engineers solved it with incandescent lens boxes. These fixtures blend smoothly into the architectural design — give a narrow concentrated beam that easily bridges the gap between ceiling

and floor. Certainly an excellent solution to the old problem of relighting older style buildings.

### Shown is the Merchants National Bank, Salem, Massachusetts

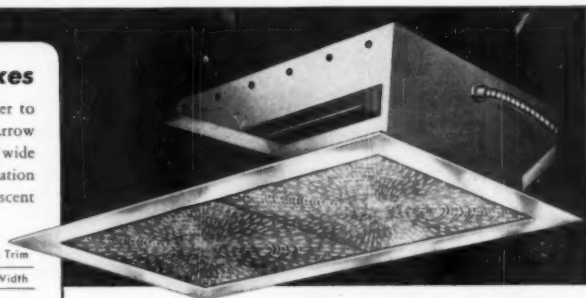
Architect, W. H. Jones & Son, Melrose, Mass.; Engineer, John R. McVey, Salem Electric Lighting Company; Electrical Contractor, Wilson & Robinson; Distributor, DesRoches Electric Supply Company. Ceiling height, 24½ feet. Fixtures, 24, 2 gang recessed lens boxes for top service with Holophane 21765 lens-reflector combination. Designed for 300 watt incandescent lamps to provide an average of 35 footcandles in service in work areas.

### ... with Litecontrol Lens Boxes

These Litecontrol flush lens boxes can be the answer to many of your lighting problems. Use them with "narrow beam" lens and reflector combinations or with "wide beam" combinations. Be sure and write for information on the many other types of fluorescent and incandescent fixtures manufactured by Litecontrol.

Catalog Number	Lamp Wattage	Roughing Box			Exposed Trim	
		Length	Width	Depth	Length	Width
12F-V30-2	2-150†-300	25"	12½"	11¼"	27"	14⅞"
*12F-V30S-2	2-150†-300	25"	12½"	11¼"	27"	14⅞"
12F-V30-3	3-150†-300	37"	12½"	11¼"	39"	14⅞"
*12F-V30S-3	3-150†-300	37"	12½"	11¼"	39"	14⅞"
12F-V30-45Q	4-150†-300	26"	26"	12"	28"	28"
*12F-V30S-45Q	4-150†-300	26"	26"	12"	28"	28"

\*Supplied with Holophane Square Reflector for wide beam spread.  
†Use ½" Socket Extension. Note all these boxes available with top service for relamping from above.



**LITECONTROL**  
*Fixtures*  
KEEP UPKEEP DOWN

LITECONTROL CORPORATION  
36 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS



of helpful Facts, Figures and Photos  
of **HAZACORD MOLD CURED**  
**FLEXIBLE CORDS and PORTABLE CABLES**

**HAZACORD PORTABLE**  
with mold-cured Housgren 287 sheath  
Table 1  
TYPE W - 600 VOLTS  
(in Sheathing - in Braiding - in Covering)

Cable Size		Weight (lb./ft.)		Resistance (ohms/1000 ft.)		Capacitance (p.f./1000 ft.)	
No.	Size	Wt.	Res.	Cap.	Wt.	Res.	Cap.
1	1/2"	1.2	1.2	1.2	1.2	1.2	1.2
2	3/4"	1.8	1.8	1.8	1.8	1.8	1.8
3	1"	2.4	2.4	2.4	2.4	2.4	2.4
4	1 1/4"	3.6	3.6	3.6	3.6	3.6	3.6
5	1 3/4"	4.8	4.8	4.8	4.8	4.8	4.8
6	2"	6.0	6.0	6.0	6.0	6.0	6.0
7	2 1/2"	7.2	7.2	7.2	7.2	7.2	7.2
8	3"	8.4	8.4	8.4	8.4	8.4	8.4
9	3 1/2"	9.6	9.6	9.6	9.6	9.6	9.6
10	4"	10.8	10.8	10.8	10.8	10.8	10.8
11	4 1/2"	12.0	12.0	12.0	12.0	12.0	12.0
12	5"	13.2	13.2	13.2	13.2	13.2	13.2
13	5 1/2"	14.4	14.4	14.4	14.4	14.4	14.4
14	6"	15.6	15.6	15.6	15.6	15.6	15.6
15	6 1/2"	16.8	16.8	16.8	16.8	16.8	16.8
16	7"	18.0	18.0	18.0	18.0	18.0	18.0
17	7 1/2"	19.2	19.2	19.2	19.2	19.2	19.2
18	8"	20.4	20.4	20.4	20.4	20.4	20.4
19	8 1/2"	21.6	21.6	21.6	21.6	21.6	21.6
20	9"	22.8	22.8	22.8	22.8	22.8	22.8
21	9 1/2"	24.0	24.0	24.0	24.0	24.0	24.0
22	10"	25.2	25.2	25.2	25.2	25.2	25.2
23	10 1/2"	26.4	26.4	26.4	26.4	26.4	26.4
24	11"	27.6	27.6	27.6	27.6	27.6	27.6
25	11 1/2"	28.8	28.8	28.8	28.8	28.8	28.8
26	12"	30.0	30.0	30.0	30.0	30.0	30.0
27	12 1/2"	31.2	31.2	31.2	31.2	31.2	31.2
28	13"	32.4	32.4	32.4	32.4	32.4	32.4
29	13 1/2"	33.6	33.6	33.6	33.6	33.6	33.6
30	14"	34.8	34.8	34.8	34.8	34.8	34.8
31	14 1/2"	36.0	36.0	36.0	36.0	36.0	36.0
32	15"	37.2	37.2	37.2	37.2	37.2	37.2
33	15 1/2"	38.4	38.4	38.4	38.4	38.4	38.4
34	16"	39.6	39.6	39.6	39.6	39.6	39.6
35	16 1/2"	40.8	40.8	40.8	40.8	40.8	40.8
36	17"	42.0	42.0	42.0	42.0	42.0	42.0
37	17 1/2"	43.2	43.2	43.2	43.2	43.2	43.2
38	18"	44.4	44.4	44.4	44.4	44.4	44.4
39	18 1/2"	45.6	45.6	45.6	45.6	45.6	45.6
40	19"	46.8	46.8	46.8	46.8	46.8	46.8
41	19 1/2"	48.0	48.0	48.0	48.0	48.0	48.0
42	20"	49.2	49.2	49.2	49.2	49.2	49.2
43	20 1/2"	50.4	50.4	50.4	50.4	50.4	50.4
44	21"	51.6	51.6	51.6	51.6	51.6	51.6
45	21 1/2"	52.8	52.8	52.8	52.8	52.8	52.8
46	22"	54.0	54.0	54.0	54.0	54.0	54.0
47	22 1/2"	55.2	55.2	55.2	55.2	55.2	55.2
48	23"	56.4	56.4	56.4	56.4	56.4	56.4
49	23 1/2"	57.6	57.6	57.6	57.6	57.6	57.6
50	24"	58.8	58.8	58.8	58.8	58.8	58.8
51	24 1/2"	60.0	60.0	60.0	60.0	60.0	60.0
52	25"	61.2	61.2	61.2	61.2	61.2	61.2
53	25 1/2"	62.4	62.4	62.4	62.4	62.4	62.4
54	26"	63.6	63.6	63.6	63.6	63.6	63.6
55	26 1/2"	64.8	64.8	64.8	64.8	64.8	64.8
56	27"	66.0	66.0	66.0	66.0	66.0	66.0
57	27 1/2"	67.2	67.2	67.2	67.2	67.2	67.2
58	28"	68.4	68.4	68.4	68.4	68.4	68.4
59	28 1/2"	69.6	69.6	69.6	69.6	69.6	69.6
60	29"	70.8	70.8	70.8	70.8	70.8	70.8
61	29 1/2"	72.0	72.0	72.0	72.0	72.0	72.0
62	30"	73.2	73.2	73.2	73.2	73.2	73.2
63	30 1/2"	74.4	74.4	74.4	74.4	74.4	74.4
64	31"	75.6	75.6	75.6	75.6	75.6	75.6
65	31 1/2"	76.8	76.8	76.8	76.8	76.8	76.8
66	32"	78.0	78.0	78.0	78.0	78.0	78.0
67	32 1/2"	79.2	79.2	79.2	79.2	79.2	79.2
68	33"	80.4	80.4	80.4	80.4	80.4	80.4
69	33 1/2"	81.6	81.6	81.6	81.6	81.6	81.6
70	34"	82.8	82.8	82.8	82.8	82.8	82.8
71	34 1/2"	84.0	84.0	84.0	84.0	84.0	84.0
72	35"	85.2	85.2	85.2	85.2	85.2	85.2
73	35 1/2"	86.4	86.4	86.4	86.4	86.4	86.4
74	36"	87.6	87.6	87.6	87.6	87.6	87.6
75	36 1/2"	88.8	88.8	88.8	88.8	88.8	88.8
76	37"	90.0	90.0	90.0	90.0	90.0	90.0
77	37 1/2"	91.2	91.2	91.2	91.2	91.2	91.2
78	38"	92.4	92.4	92.4	92.4	92.4	92.4
79	38 1/2"	93.6	93.6	93.6	93.6	93.6	93.6
80	39"	94.8	94.8	94.8	94.8	94.8	94.8
81	39 1/2"	96.0	96.0	96.0	96.0	96.0	96.0
82	40"	97.2	97.2	97.2	97.2	97.2	97.2
83	40 1/2"	98.4	98.4	98.4	98.4	98.4	98.4
84	41"	99.6	99.6	99.6	99.6	99.6	99.6
85	41 1/2"	100.8	100.8	100.8	100.8	100.8	100.8
86	42"	102.0	102.0	102.0	102.0	102.0	102.0
87	42 1/2"	103.2	103.2	103.2	103.2	103.2	103.2
88	43"	104.4	104.4	104.4	104.4	104.4	104.4
89	43 1/2"	105.6	105.6	105.6	105.6	105.6	105.6
90	44"	106.8	106.8	106.8	106.8	106.8	106.8
91	44 1/2"	108.0	108.0	108.0	108.0	108.0	108.0
92	45"	109.2	109.2	109.2	109.2	109.2	109.2
93	45 1/2"	110.4	110.4	110.4	110.4	110.4	110.4
94	46"	111.6	111.6	111.6	111.6	111.6	111.6
95	46 1/2"	112.8	112.8	112.8	112.8	112.8	112.8
96	47"	114.0	114.0	114.0	114.0	114.0	114.0
97	47 1/2"	115.2	115.2	115.2	115.2	115.2	115.2
98	48"	116.4	116.4	116.4	116.4	116.4	116.4
99	48 1/2"	117.6	117.6	117.6	117.6	117.6	117.6
100	49"	118.8	118.8	118.8	118.8	118.8	118.8
101	49 1/2"	120.0	120.0	120.0	120.0	120.0	120.0
102	50"	121.2	121.2	121.2	121.2	121.2	121.2
103	50 1/2"	122.4	122.4	122.4	122.4	122.4	122.4
104	51"	123.6	123.6	123.6	123.6	123.6	123.6
105	51 1/2"	124.8	124.8	124.8	124.8	124.8	124.8
106	52"	126.0	126.0	126.0	126.0	126.0	126.0
107	52 1/2"	127.2	127.2	127.2	127.2	127.2	127.2
108	53"	128.4	128.4	128.4	128.4	128.4	128.4
109	53 1/2"	129.6	129.6	129.6	129.6	129.6	129.6
110	54"	130.8	130.8	130.8	130.8	130.8	130.8
111	54 1/2"	132.0	132.0	132.0	132.0	132.0	132.0
112	55"	133.2	133.2	133.2	133.2	133.2	133.2
113	55 1/2"	134.4	134.4	134.4	134.4	134.4	134.4
114	56"	135.6	135.6	135.6	135.6	135.6	135.6
115	56 1/2"	136.8	136.8	136.8	136.8	136.8	136.8
116	57"	138.0	138.0	138.0	138.0	138.0	138.0
117	57 1/2"	139.2	139.2	139.2	139.2	139.2	139.2
118	58"	140.4	140.4	140.4	140.4	140.4	140.4
119	58 1/2"	141.6	141.6	141.6	141.6	141.6	141.6
120	59"	142.8	142.8	142.8	142.8	142.8	142.8
121	59 1/2"	144.0	144.0	144.0	144.0	144.0	144.0
122	60"	145.2	145.2	145.2	145.2	145.2	145.2
123	60 1/2"	146.4	146.4	146.4	146.4	146.4	146.4
124	61"	147.6	147.6	147.6	147.6	147.6	147.6
125	61 1/2"	148.8	148.8	148.8	148.8	148.8	148.8
126	62"	150.0	150.0	150.0	150.0	150.0	150.0
127	62 1/2"	151.2	151.2	151.2	151.2	151.2	151.2
128	63"	152.4	152.4	152.4	152.4	152.4	152.4
129	63 1/2"	153.6	153.6	153.6	153.6	153.6	153.6
130	64"	154.8	154.8	154.8	154.8	154.8	154.8
131	64 1/2"	156.0	156.0	156.0	156.0	156.0	156.0
132	65"	157.2	157.2	157.2	157.2	157.2	157.2
133	65 1/2"	158.4	158.4	158.4	158.4	158.4	158.4
134	66"	159.6	159.6	159.6	159.6	159.6	159.6
135	66 1/2"	160.8	160.8	160.8	160.8	160.8	160.8
136	67"	162.0	162.0	162.0	162.0	162.0	162.0
137	67 1/2"	163.2	163.2	163.2	163.2	163.2	163.2
138	68"	164.4	164.4	164.4	164.	164.4	164.4



# BIDDLE

## Instrument News

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

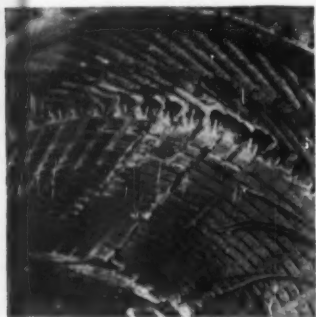
NUMBER 3 OF A SERIES

JAMES G. BIDDLE CO., 1316 ARCH ST., PHILADELPHIA 7, PA.

### REDUCE ELECTRICAL BREAKDOWNS IN YOUR PLANT with a Regular Schedule of INSULATION RESISTANCE TESTS

Irwin Robbins, Electrical Engineer, Factory Mutual Engineering Division writes in a recent article in PLANT ENGINEERING:

*"The greatest single cause of electrical machinery breakdown is the failure of the insulation. Despite improvements in insulating materials in the past decade, insulation is still the most vulnerable part of an electrical machine..."*



Typical damage to generator windings

It naturally follows that a regular program of checking the condition of electrical insulation pays off. Much can be saved in prevention of motor damage, wasted current, loss of production and danger to life and property.

For more than a half century the Megger Insulation Tester has been a highly effective means for testing any type of electrical equipment, whether a-c or d-c and irrespective of the voltage rating of the apparatus. It is direct-reading, easy to use and has its own source of power. It permits non-destructive tests which disclose incipient insulation weaknesses, rather than merely signaling insulation breakdown that has already occurred.

A series of periodic tests recorded on charts supplied with each Megger set assures you that the insulation of a machine is holding up... or warns you that insulation is becoming weaker and conditions should be investigated.

#### Most Trouble is Caused by Dirt or Moisture

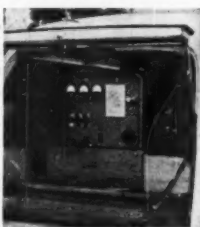
It is more economical to blow out dust, dry out coil windings, eliminate oil conditions, or even replace a motor or generator on off-hours at the convenience of the production and maintenance departments—than to have trouble strike unexpectedly and production interrupted indefinitely.

The story of electrical insulation resistance is told in our easy-to-read booklet entitled "For Practical Men". Most maintenance men, who have seen it, have requested extra copies for their associates. Yours will be mailed free of charge by simply requesting Bulletin 21P8-ECM.

#### OUR APPLICATIONS ENGINEER COMPLETES 7000 MILE TRIP with NEW IMPULSE CABLE FAULT LOCATOR

Photo shows installation of the instrument in the company car, during a coast-to-coast demonstration tour.

Designed primarily for locating faults on lead-covered cable installed in ducts, this new equipment has application also on aerial and buried cable. It has proved highly effective in utility and industrial service. If you have cable fault locating problems, write for a copy of Bulletin 65-ECM.



#### ELECTRICAL MAINTENANCE APPLICATIONS of LOW RESISTANCE MEASUREMENTS

##### Cable and Conductor Joints Oil Circuit Breaker Assemblies Rotating Equipment Transformers and Coils

High-resistance conductor joints and connections cause objectionable voltage drops, loss of power, and damage from localized heating. Quick and reliable measurements of joint and contact resistance during manufacture, at installation, and periodically while in service are therefore good insurance against malfunctioning and trouble.

Several of the joints and contacts throughout oil circuit breakers, from top-terminal of the bushings to associated bushings, may give serious trouble when unnecessary heating develops.

In rotating equipment shorted commutator bars, shorts in armature coils, and shorts between equalizers or cross connections, and also high resistance joints between commutator bars and risers, spell inefficient performance and trouble.

Proper winding resistances of transformers and of coils are as important as in any other electric circuit, with one exception—such windings have inductive characteristics, as well as d-c resistance.

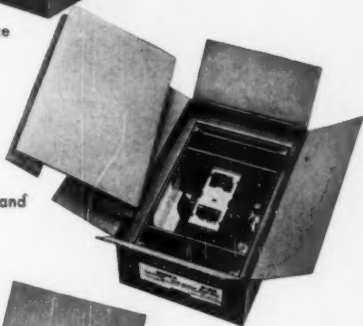
Anyone familiar with these types of equipment can measure ohmic resistances down to a few millionths of an ohm with the DUCTER® Low Resistance Ohmmeter. Valuable information on this subject is contained in our Bulletin 24-25-ECM.

*We are constantly publishing new technical bulletins on Biddle Instruments. A complete list of our latest bulletins will be mailed you on request, so that you may check it to bring your files up to date.*

# THE CUTLER-HAMMER Flexible Merchandising Package ON M08 MULTI-BREAKERS



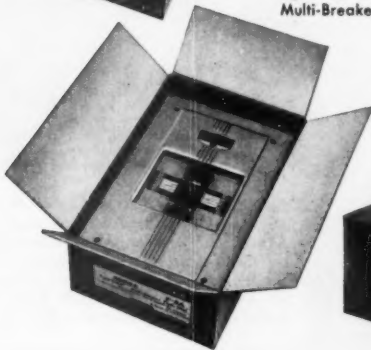
**1** Remove carton containing basic device from shelf.



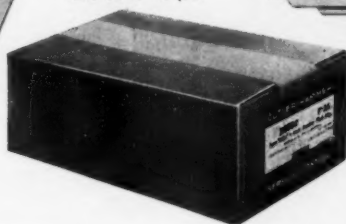
**2** Open carton and remove filler.



**3** Insert Ad-Ons in space thus provided.



**4** Add cover to Multi-Breaker.



**5** Resealed carton now contains M08 Multi-Breaker tailored to the job.



**For prompt off-the-shelf meeting  
of all job requirements  
from modest stocks**

A unique and exclusive Cutler-Hammer merchandising arrangement cuts down inventory requirements, handling operations and record-keeping, while meeting *all* M08 Multi-Breaker job requirements from this modest stock. The fundamental of this plan is simple stocking, simple assembly, simple handling. The basic Cutler-Hammer M08 Multi-Breaker device, a 4-circuit block mounted in a box with neutral and handle ties, is packaged in its own carton. So are Ad-On Breakers and Multi-Breaker covers of both surface and flush types packaged individually. The basic unit meets minimum requirements for most applications. But its carton is so constructed it will receive any Ad-On Breakers which may be required to adapt the basic unit to the specific requirements of the individual job . . . and the carton will also receive the required cover, flush or surface type. See photos at left. Handling, record-keeping, need to recheck constantly, possibility of loss are reduced if not eliminated. You will like this system. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

# It's easier to work

# *the Lightweight way*



Installing ELECTRUNITE E.M.T. in concrete slab construction at recently completed apartment project in Cleveland. In this, as in countless other installations, worker fatigue was effectively lessened by the use of lightweight ELECTRUNITE E.M.T. (Electrical Metallic Tubing).

# with **ELECTRUNITE** **E. M. T.**

Yes, it's easier to work the lightweight way with ELECTRUNITE E.M.T., and that's the reason why thousands of electricians — journeymen and apprentices alike — prefer this *modern* rigid steel raceway.

Weighing less than half as much as heavy threaded conduit, *threadless* ELECTRUNITE E.M.T. is easier to handle...easier to bend...easier to couple...easier to install, particularly in overhead or hard-to-reach locations.

And despite the fact that ELECTRUNITE E.M.T. takes the "arm-ache" and "back-break" out of raceway installations, it furnishes dependable, safe wiring protection. It is approved by the National Electrical Code and modern local codes for use in exposed, concealed and concrete slab construction.

Get the complete story from your ELECTRUNITE Distributor, or write today to:

**REPUBLIC STEEL CORPORATION**  
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO  
Export Department: Chrysler Building, New York 17, N. Y.

## THE ELECTRUNITE BENDING SYSTEM



Three good reasons why many contractors and journeymen alike prefer *modern* ELECTRUNITE E.M.T. over all other types of rigid steel raceways.



*Republic*  
**ELECTRUNITE E.M.T.**

**LIGHTWEIGHT THREADLESS RIGID STEEL RACEWAY**

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . AUGUST, 1950

# IT'S A PROVEN MONEY-SAVER!

## TOMIC'S 2<sup>in</sup> BOX or FIXTURE HANGER FOR CONCRETE WORK



**1**

The above drawing shows the application of the New TOMIC Box Hanger.

CAT. NO. 90



Extra Centering Clamps (Cat. No. 91) available at nominal cost.

**The Answer To The Industry's Two Toughest Problems!**  
(FOR SECURING BOXES—FOR HANGING FIXTURES)  
**Check The Amazing Features!**

**NO MORE LOST BOXES**

—no more chiseling  
—no more patchwork.

**BOX WILL NOT SHIFT**

when concrete is being poured.

**BOX REMAINS CLEAN**

at all times. Threads in boxes protected.

**MAKES CONDUIT PLUGGING UNNECESSARY**

—a distinct saving.

**OUTMODES PREVIOUS METHODS**

—superior in every way.

**ALL BUT CENTERING CLAMP RECLAIMABLE**

—hangers can be used again and again.

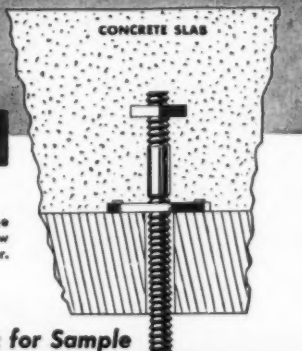
## TOMIC'S *New* FIXTURE HANGER

*Quickly and easily installed on deck*

**2**

- Makes Fixture Hanging Safe and Sure
- Ample Thread Allowance For All Conditions
- Simplifies Modern Fixture Hanging
- Provides Fixture Mounting Studs Outside of Outlet Boxes

This drawing shows the application of the New TOMIC Fixture Hanger.



Available Through Better Jobbers Everywhere—Write Tomic for Sample

# TOMIC SALES & ENGINEERING CO.

4864 Woodward Ave.

Detroit 1, Michigan



# Guard Against Atmospheric Hazards...

WITH

## Century

# PROTECTED MOTORS



Drip Proof



Splash Proof



Totally Enclosed Fan Cooled



Explosion Proof



### ALTERNATING CURRENT MOTORS

#### POLYPHASE

Squirrel Cage Induction—1/6 to 400 H.P.  
Wound Rotor Motors—1 to 400 H.P.  
Synchronous Motors—20 to 150 H.P.

#### SINGLE PHASE

Split Phase Induction—1/6, 1/4, 1/3 H.P.  
Capacitor—1/6 to 20 H.P.  
Repulsion Start, Brush Lifting, Induction—1/2 to 20 H.P.

### DIRECT CURRENT MOTORS

1/6 to 300 H.P.

### GENERATORS

AC, 63 to 250 KVA  
DC, 75 to 200 KW

### GEAR MOTORS

1/8 to 1-1/2 H.P.

### MOTOR GENERATOR SETS

AC to DC, AC to AC  
DC to DC, DC to AC

Open Protected, Splash Proof, Totally Enclosed Fan Cooled, Explosion Proof.

Ball Bearing motors are factory lubricated for several years' normal service. Bearing housing construction permits easy re-lubrication when unusual service demands it.

To guard your production against the destructive effects of atmospheric hazards, Century offers four types of protective motor frames.

**DRIP PROOF**—meets the requirements of most installations. Use it where operating conditions are relatively clean and dry. Top half of the frame is enclosed to keep out falling solids and dripping liquids.

**SPLASH PROOF**—keeps splashing liquids out of the motor even when the frame is washed with the full force of a hose. Use Century Splash Proof motors indoors or outdoors.

**TOTALLY ENCLOSED FAN COOLED**—resists the hazards of abnormal concentrations of dusts, powders, grit, oil mists, acid and alkali fumes.

**EXPLOSION PROOF**—protects life and property in atmospheres charged with explosive dusts or vapors.

The properly selected protection with the wide variation of starting torque characteristics to choose from provides long operating life and improves the production of the driven equipment.

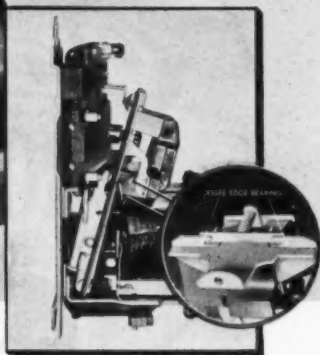
Century motors are available in a wide range of kinds and types—in sizes from 1/8 to 400 horsepower—for single phase, polyphase and direct current applications.

Specify Century motors for all your electric power requirements.

**CENTURY ELECTRIC CO.** 1806 Pine St. • St. Louis 3, Mo.  
Offices and Stock Points in Principal Cities

YOU CAN BE SURE... IF IT'S  
**Westinghouse**

**FRICTION-  
FREE**



**Life-Linestarter\***

**Only one moving element —  
a seesaw balanced on a knife-edge**

No complex linkages in the contact closing mechanism of the new Westinghouse Life-Line starter, which is years ahead in its principle of operation. No sliding surfaces to bend. No lubrication needed. Nothing to stick or jam. The new principle, backed by 40 years of experience and perfected by more than 6 years of laboratory and field tests, opens the way to fewer outages, increased production, lower operating costs.

Compare this operating principle with that of other starters. Compare, too, for positive protection—compare the positive kickout spring which provides the force needed to open the contacts—for rapid, uniform action, independent of gravity. Also compare Life-Line starter for uniformity and completeness of line,

\*Trade Mark

NEMA sizes 0 through 4, ease of installation and other key advantages.

Get the facts. Your local Westinghouse representative is ready to show you "the inside story" by Trans-Vision. Or write for 20-page booklet B-4677. Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Penna.

J-30021

**Westinghouse**  
**Life-Linestarter**



**TOMORROW'S STARTER—TODAY!**

# CRESCENT ENDURITE

*New!  
Improved!*

## DUAL PURPOSE WIRE & CABLE



Listed By Underwriters' Laboratories As

TYPE RH-75° C

or

TYPE RW-60° C

- In DRY locations this wire is rated as a type RH with its high permissible operating temperature and consequent greater current carrying capacity.

- In WET locations this same wire with its excellent moisture-resisting qualities is rated as a type RW.

- Except where voltage drop is the determining factor, ENDURITE when used as a type RH allows greater current-carrying capacity, so smaller size of cable and in many cases smaller size of conduit can be used at less cost than

would be required for Type R or Type T or TW for the same load.

- CRESCENT ENDURITE when used in sizes #6 A.W.G. and larger in dry locations will in most cases give the lowest installed cost per ampere of useful circuit capacity.



# CRESCENT

WIRE & CABLE

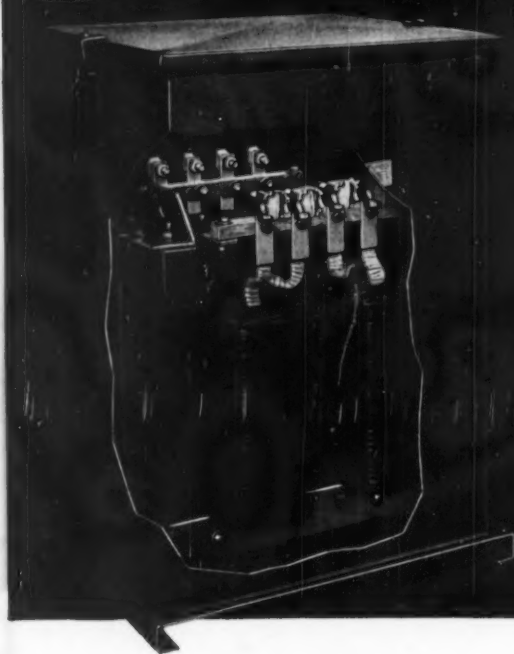


**CRESCENT INSULATED WIRE & CABLE CO.**

TRENTON, N. J.

# Cut Waste Power!

**ALLIS-CHALMERS  
Dry-Type  
Transformers**



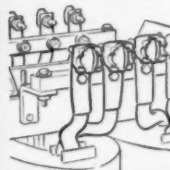
**BEFORE**



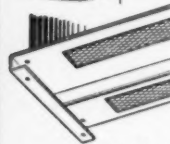
**AFTER**



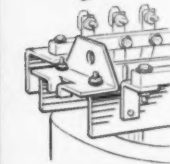
**ELIMINATE** long runs of secondary copper . . . save through reduced power consumption, improved machine and lighting efficiency, increased system flexibility, lower cable installation costs.



**TIME-SAVING** solderless connectors are standard on units 15 through 50 kva, single phase, and 37½ through 100 kva, three phase. On larger sizes, flat drilled bars are arranged vertically for any connector.



**RAPID THRU-DRAFT** ventilation is obtained by air inlet through base and outlet through cover overhang. Natural chimney draft action draws air through vertical air ducts in coils. Class B insulation used throughout.



**BUILT** for hard service. Sturdy side frames retain alignment and rigidity of core and coil structure. Case is all-welded, *Spra-Bonderized*, receives 3 coats of baked-on resilient paint.

**L**OOKING FOR WAYS to cut production costs? Here's a tip — check for below-normal voltages at lamps, motors and heating loads.

Did you know that a 10% correction in voltage will recover a 30% illumination loss? . . . 20% motor starting torque loss? . . . 19% output loss in heating operations?

To side-step these losses and get the most out of your power bill, install Allis-Chalmers "dry-types" right at loads. You'll 1) improve voltage regulation for better lamp, motor, and thermal

efficiency; 2) make added savings through reduced line losses.

And they're easy to mount. Put them on overhead platforms, machines, posts or walls. No firewall needed.

Transformers are stocked country-wide in popular ratings. For information and bulletin 61B6382A contact your A-C Dealer or A-C Sales Office.

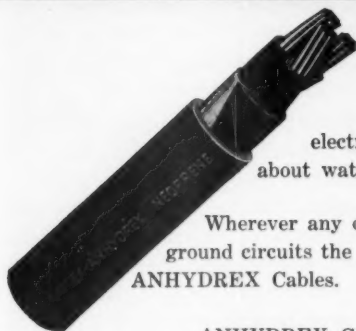
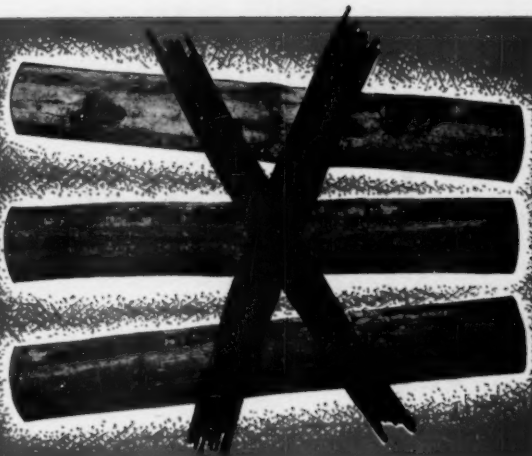
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ALLIS-CHALMERS, 930A SO. 70 ST.  
MILWAUKEE, WIS.

## ALLIS-CHALMERS



# GOOD-BYE CORROSION



'No need any longer to worry about stray currents, vibration, or harmful soil acids knocking out underground electrical systems. And at the same time... 'No need to worry about water and moisture.

Wherever any one or all of these hazards threaten the performance of underground circuits the problem can be solved, easily and economically, with Simplex-ANHYDREX Cables.

ANHYDREX Cables are neoprene jacketed; have no metallic coverings to crystallize and corrode, and are tops for protection against rough handling; against the soil acids and alkalies underground; and flame, heat, sunlight and weathering where they come up above ground. They are protected against water and moisture by the insulation that has proved itself to be the most stable in wet locations, the insulation that has never failed due to water absorption — ANHYDREX.

Bury ANHYDREX Cables directly in earth or run them through ducts. However installed, you'll find they provide the trouble-free service that's a "must" for transmission and distribution systems, signal and control circuits, underground entrances, street, airport, and park lighting. For complete information, fill out and return the coupon below.

# Simplex\_

## WIRES & CABLES

**SIMPLEX WIRE & CABLE CO.**  
79 Sidney St., Cambridge 39, Mass.

SIMPLEX WIRE & CABLE CO. 79 SIDNEY ST., CAMBRIDGE 39, MASS.	
GENTLEMEN: PLEASE SEND A COPY OF CATALOG 1013 TO:	
NAME _____	TITLE _____
COMPANY _____	
STREET _____	
CITY _____	STATE _____



# look at it this way

## "Just any" electrical system won't do

A modern distribution system can make electric power do more of *your kind* of work . . . if it's planned to meet the specific requirements of your plant.

No one system can answer all problems. That's why it's imperative that your system be planned to meet *your* individual needs.

Power centers provide the simplest way—the low-cost way—of attaining the system you require. Westinghouse Indoor Dry-Type Power Centers also give you these advantages:

**THEY'RE SAFER**—from the hazards of fire and explosion; they have no exposed live parts. Breakers and switches have positive interlocking mechanisms, each in its separate compartment.

**THEY'RE MORE ECONOMICAL**—because they eliminate the need for costly vaults and can be located near center of load . . . resulting in shorter secondaries, lower line losses, better regulation.

**THEY COST LESS TO MAINTAIN**—no liquids to test, recondition or replace . . . no gaskets, valves or gauges. All parts are readily accessible.

Your Westinghouse Representative will be glad to discuss your system problems with you. He is prepared to offer complete system information, with advantages of each carefully weighed. Ask him for a copy of Booklet B-4045, "*Industrial Plant Distribution Systems*", and B-4162, "*Power Centers by Westinghouse*". Or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-60730

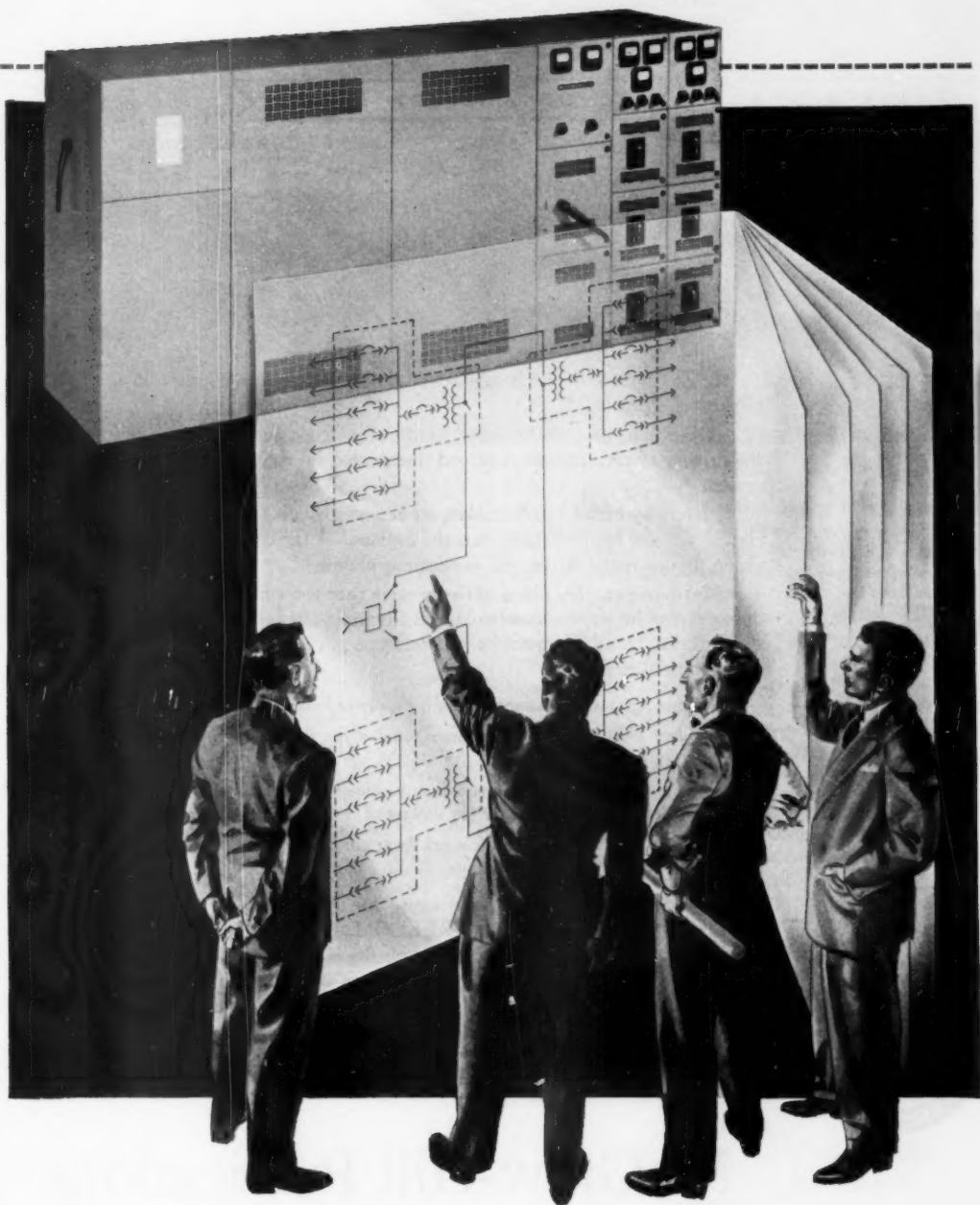
### SYSTEMS ARE "SPECIALISTS"

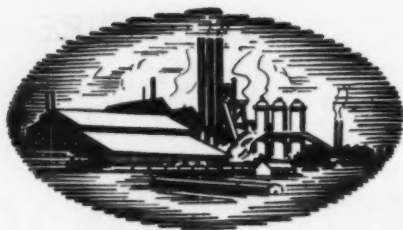
Of the eleven basic types of electrical distribution systems for industrial plants, no two offer the same combination of advantages. That's why a system designed for economical operation in one plant could prove uneconomical in another. To evaluate the system features your plant requires, consult your Westinghouse representative.

**Westinghouse**  
**POWER CENTERS**



YOU CAN BE **SURE**.. IF IT'S  
**Westinghouse**





1900 ★ THE MIRACLE OF AMERICA ★ 1950

# Freedom and Progress

It's no stretch of the imagination, rather, robust realism to call our past half century a Miracle—U.S.A.

America has set an amazing record of progress in 50 years—but a moment in the history of civilization. A record unequalled by any other political or economic system.

Merely by broad brush strokes, we can all visualize this miracle. Remember the crystal set, the hand-cranked car, the biplane? A far cry from our FM radio, television, hydro-matic drive and supersonic planes.

And here's another phase of the miracle that went hand-in-hand with these and the myriad of intertwined technological advances—ranging from the radio telephone and Bakelite to the X-ray tube and teletype . . . and to atomic energy and its untold potentialities.

- ★ Since 1900 we have increased our supply of machine power  $4\frac{1}{2}$  times.
- ★ Since 1900 we have more than doubled the output each of us produces for every hour we work.
- ★ Since 1900 we have increased our annual income from less than \$2400 per household to about \$4000 (in dollars of the same purchasing power), yet . . .
- ★ Since 1900 we have cut 18 hours from our average work week—equivalent to two present average workdays.

How did we do it? The basic cause for this composite miracle has been the release of human energy through FREEDOM, COMPETITION and OPPORTUNITY. And one of the most important results is the fact that more people are able to enjoy the products of this free energy than in any other system the world has ever known.

THIS IS THE MIRACLE OF AMERICA . . . it's only beginning to unfold.

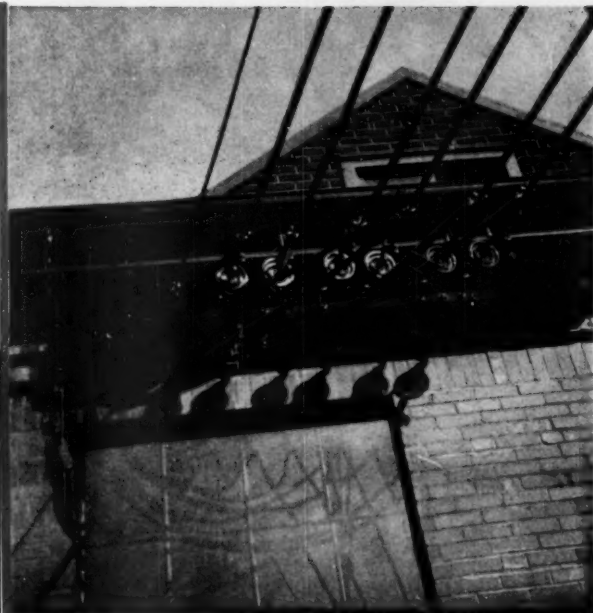
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## McGraw-Hill Publications



**FOR OVERHEAD ...**

**OR UNDERGROUND USE**



**You can depend on  
tough, long-lasting  
neoprene-jacketed  
cable**

Neoprene-jacketed cable withstands sunlight, weather, ozone, heat and cold...resists chemical vapors in industrial areas. It stands up under abrasion from trees; will not festoon. And underground, a tough, resilient neoprene jacket acts as a protective armor against crushing and denting by settling earth. It's undamaged by acid or alkaline soil; resists the effect of galvanic action, which is destructive to metal sheaths.

So make sure the cable you use is the kind you can depend on—with a jacket of Du Pont neoprene. Although Du Pont does not make finished neoprene products, leading wire and cable manufacturers use neoprene for their quality constructions. Your distributor can supply you. And if you'd like to read about new neoprene applications which may help you, we'll gladly put you on our mailing list for "The Neoprene Notebook." Write: E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Div., T-8, Wilmington 98, Delaware.

# NEOPRENE

*The rubber made by Du Pont since 1932*



**BETTER THINGS FOR BETTER LIVING...THROUGH CHEMISTRY**

# Stab-lok..

'APPROVED BY UNDERWRITERS' LABORATORIES



**Stab-lok** outmodes all popular fusible equipment up to 60 amps!

REGISTRATION APPLIED FOR

"BIGGEST business opportunity in years!" "Outmodes practically all of today's popular fusible devices!" "Safest, most convenient circuit protection at unbelievably low cost!" "No better breaker at any price!"... That's what they're saying about the new STAB-LOK... and here's why:

The STAB-LOK System is simplicity itself. It consists of individual STAB-LOK Circuit Breakers and only 9 STAB-LOK Enclosures. By snapping breakers of the required ampere ratings into the right-size enclosure you can meet practically any circuit protection requirement in seconds.

Not only is the Federal Noark individual pole



# BETTER CIRCUIT BREAKERS

## - AT FUSE BOX PRICES!

### INDIVIDUAL **Stab-lok** CIRCUIT BREAKERS

STAB-LOK Circuit Breakers have a new self-locking plug-in method of breaker insertion. Breaker stabs make instant, positive contact with specially designed busses. Cooperative thermal-magnetic trip action passes momentary current surges but responds at once to shorts and dangerous overloads. Doubly dependable STAB-LOK breakers come in a range of 15, 20, 25, 30, 35, 40 and 50 amperages, single and simultaneous trip double pole.

The combination of matchless protection and low cost in the STAB-LOK System has been attained only by Federal Noark's engineered use of unique developments and by specialized assembly techniques that slash costs.



**NEW STAB-LOK SELF-LOCKING PLUG-IN METHOD:** You can insert a STAB-LOK Breaker in "no time". Simply put end of breaker under hook and push breaker into place. Stabs make instant contact and are locked in place without using screws.



Single pole STAB-LOK. Its complete metal heart is micromatically calibrated before insertion in case . . . only one solderless terminal . . . automatic reset . . . other unique features.

Double pole STAB-LOK. Its simultaneous trip action assures double pole protection. No handle ties. Only popular priced breaker with this feature.



### NEW **Stab-lok** ENCLOSURES

Most of the new STAB-LOK Enclosures are the unique Noark "combination" type for either flush or surface mounting. Each enclosure has an insulated neutral which is groundable on all equipment suitable for service entrance . . . Their capacity range constitutes a complete line that replaces *loadcenters* up to 16 circuits, *panelboards* up to 20 circuits, and fusible *switches* up to 60 amps.



**STAB-LOK "FLUSH-SURFACE" ENCLOSURE:** "Flush-Surface" Enclosures are delivered with picture-type frame in place and ready for surface mounting. For flush mounting in plastered walls, discard frame and mount box on studding; in dry walls, same procedure except cut hole in wall board to dimensions of inside flange.

STAB-LOK System the most flexible and convenient, it is also the most economical ever devised. STAB-LOK enables you to get CIRCUIT

BREAKER PROTECTION AT FUSE BOX PRICES. Federal Electric Products Company, 50 Paris St., Newark 5, New Jersey.



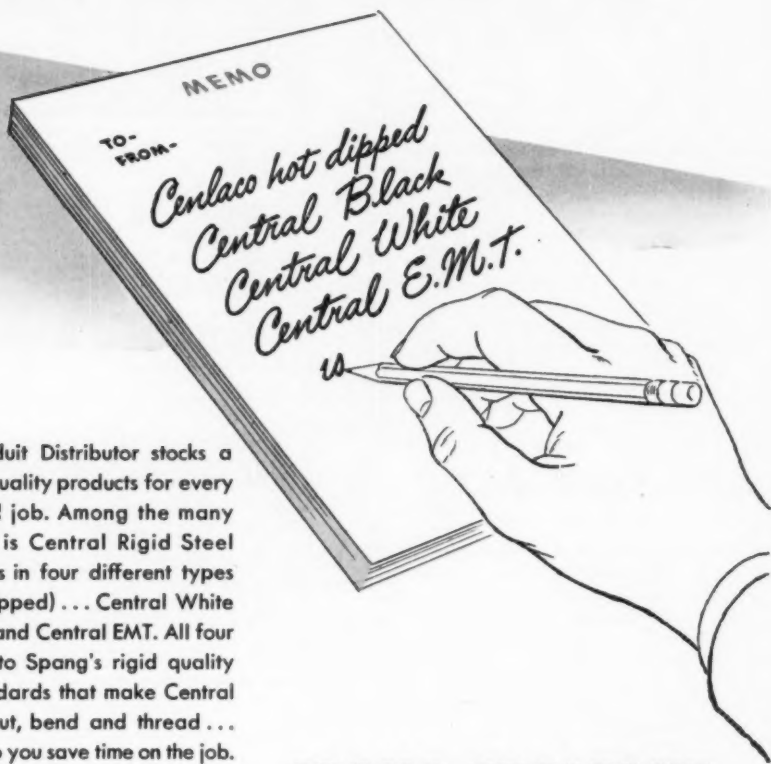
## FEDERAL NOARK

### Stab-lok Circuit Breaker System

Complete line of Federal Electric Products includes Motor Controls, Safety Switches, Service Equipment, Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct ★ Sales Offices in principal cities.

**YOU NAME IT...**

**...YOUR CENTRAL CONDUIT  
DISTRIBUTOR *has it***



Your Central Conduit Distributor stocks a wide selection of quality products for every type of electrical job. Among the many lines he handles is Central Rigid Steel Conduit that comes in four different types—Centlaco (hot dipped) . . . Central White . . . Central Black and Central EMT. All four types are made to Spang's rigid quality standards . . . standards that make Central Conduit easy to cut, bend and thread . . . standards that help you save time on the job.

Next time you need conduit or other electrical supplies, call your Central Conduit Distributor. You name it . . . he has it.

## **SPANG-CHALFANT**

Division of The National Supply Company  
General Sales Office: Grant Bldg., Pittsburgh, Pa.  
District Offices and Sales Representatives in Principal Cities

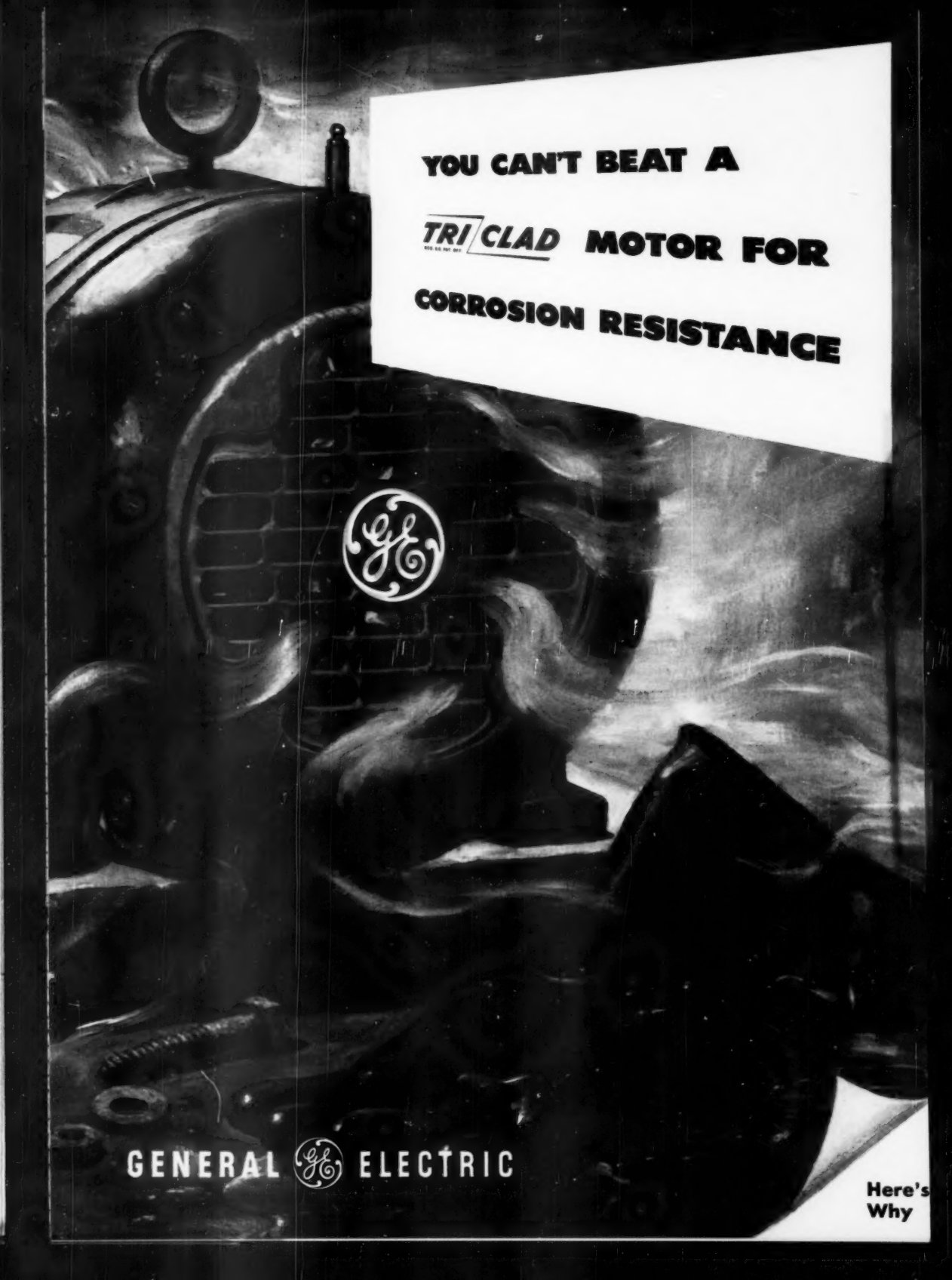


**CENLACO** a hot dipped galvanized and lacquered finish, inside and out.

**CENTRAL BLACK** permanent, baked-on black enamel finish, inside and out.

**CENTRAL WHITE** electro-galvanized outside and black enameled inside.

**EMT**—Light-weight electro-galvanized outside and durably lacquered inside.



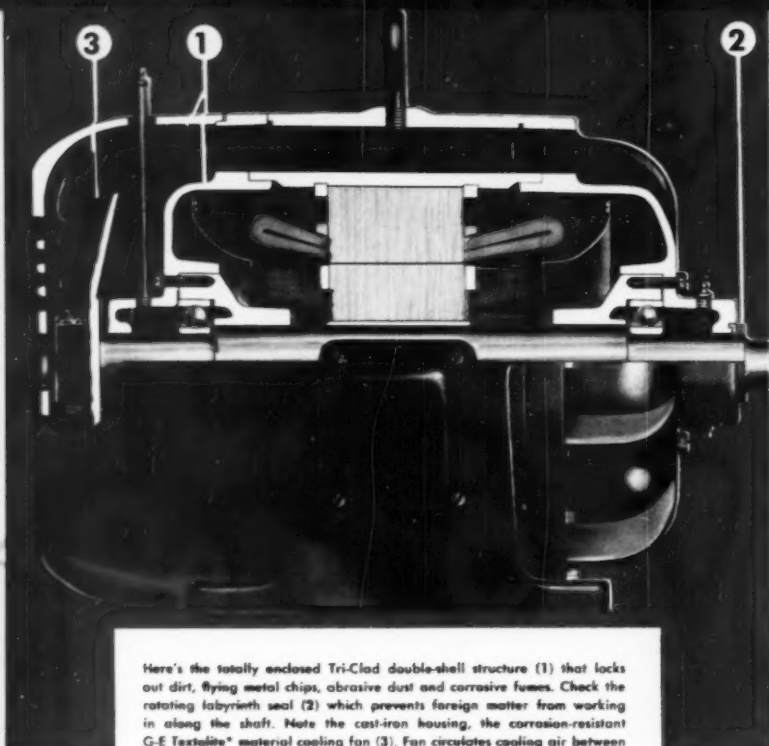
**YOU CAN'T BEAT A**

***TRI*/CLAD MOTOR FOR**

**CORROSION RESISTANCE**

**GENERAL  ELECTRIC**

**Here's  
Why**



Here's the totally enclosed Tri-Clad double-shell structure (1) that locks out dirt, flying metal chips, abrasive dust and corrosive fumes. Check the rotating labyrinth seal (2) which prevents foreign matter from working in along the shaft. Note the cast-iron housing, the corrosion-resistant G-E Textolite® material cooling fan (3). Fan circulates cooling air between the shells—no contaminated air touches the punchings or inside parts.

## You can't beat **TRI/CLAD** motors for corrosion resistance

Acid fumes, alkali dust, dye-house vapors, tropical weather — you name *your* motor "poison." You just can't beat Tri-Clad cast-iron construction for corrosion resistance.

Rolling up 6 billion hours of service on all kinds of jobs, more than 1,876,000 Tri-Clad motors tell the eye-opening story of cast-iron motor structure. You get an inherent damping action that minimizes noise and damaging vibration. You get rigidity that makes for permanent shaft alignment. (Try bolting a Tri-Clad motor to an uneven surface — the bolt will snap before you can twist the rigid frame out of line.) You get extra protection against jarring blows and rough handling. You get resistance to rust and corrosion that is not approached by any other metal used for standard motor construction today.

**WANT MOTORS THAT STAY ON THE JOB ANYWHERE?** There's a stock of Tri-Clad motors near you, in nearly all types and ratings, ready for **IMMEDIATE SHIPMENT.** Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

\*Reg. U. S. Pat. Off.  
(standard on popular sizes)

**GENERAL  ELECTRIC**

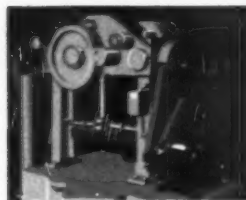
**YOU CAN'T BEAT**  
**TRI/CLAD**  
**EXTRA PROTECTION**



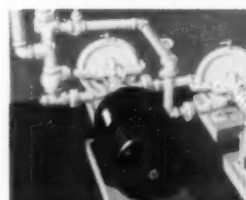
**G-E capacitor motors** for use on fans, blowers, pumps and compressors with single-phase power. From  $\frac{1}{4}$  to 5 hp.



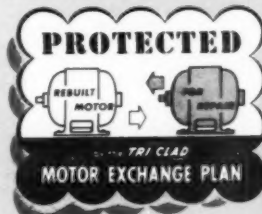
**G-E Type ACA induction motors** for adjustable speeds—provide speed ranges from 3-1 to 20-1. From 3 to 75 hp.



**G-E open (dripproof) induction motors** for constant-load, constant-speed applications. From 1 to 2000 hp.



**G-E totally enclosed motors** for outdoor operation, in abrasive dusts, or corrosive fumes. From 1 to 1000 hp.



**Look for this EXTRA  
on the motor you buy!**

## The Road Ahead

**WE SHALL BE LIVING** and working in a military economy into the indefinite future. The immediate outcome of the battle for South Korea is not important in the power strategy of the world. But the unprovoked attack proved beyond any question that the forces of Soviet imperialism are in arms seeking world conquest.

**THE ORGANIZED FORCE** of American industry poured out weapons, materials and equipment in overwhelming quantities during the last war. It can turn its efforts to the needs of war as quickly and efficiently today. And it will, as rapidly as procurement orders can be placed.

**ELECTRICAL CONSTRUCTION** work is so closely interwoven with lines of industrial production, supply and maintenance that this industry can expect to be drawn in immediately to the war effort. The first stage will be in the conversion of existing plants to new product lines. Such work must have top-most priority, even, if necessary, at the expense of delaying or shutting down commercial and institutional work now in progress.

**NEW CONSTRUCTION** for industrial and military purposes is the next stage. Will such plants go underground? On present plans, probably not. Further, existing plant structures, with some exceptions where new products are involved, are expected to provide room for most of the productive capacity required.

**ENORMOUS QUANTITIES** of building materials required for industrial expansion are going to be hard to get. Needs of the military will be great. It will take statesmanship and a long range understanding of the importance of industrial operations to channel needed materials into plant construction and alteration.

**MANY INDUSTRIES** have modernized electrically since controls were dropped. But many have not. The needs for effective electrical facilities must now be met in what promises to become another shortage economy. It is urgently necessary that such work go forward at once, while the shooting is confined to a limited area and before large numbers of men are drawn off to military service.

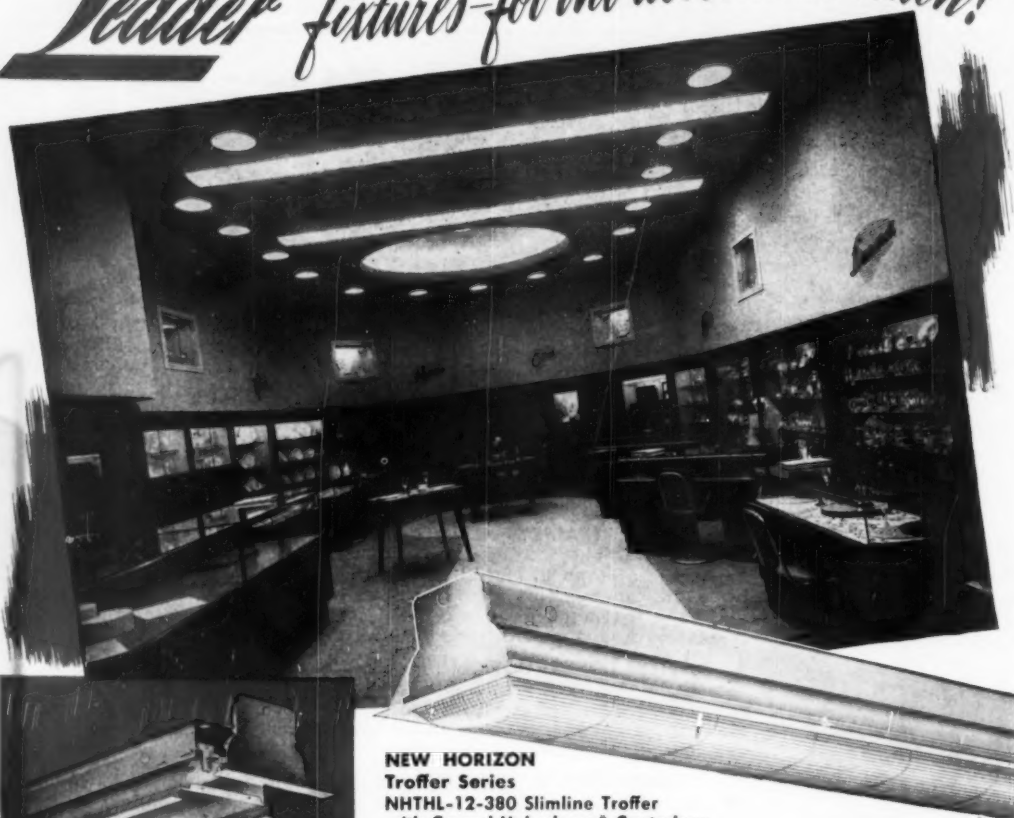
**PLANNED MAINTENANCE** was never more important. If existing electrical systems are to carry the loads of war production, they have got to be kept in top condition. The breakdown-and-repair cycle is out. It is too costly in manpower, materials and time. The alerting and strengthening of preventive electrical maintenance operation is now of vital importance.

**PRESENT COMMERCIAL** and residential work will probably hold at high levels through the year. Manpower and material needs for war will gradually close down on this activity. How much time have we got to continue the lighting modernization of stores, or the application of modern wiring to homes? At this stage, no one knows. But we can be virtually certain that eventually such work must be placed on the shelf, or continued at a closely controlled level to release materials and men.

**DON'T WE HAVE** the plant and equipment for war already? Can't we hold onto a high level of civilian economy as we grow in military might? Possibly, but not probably. With modern weapons and concepts of all-out



# *Leader fixtures for the decorator's touch!*



## **The NEW HORIZON Troffer Series**

Troffer model shown is optionally available with or without flange trim; open, baffled, louvered, or glass enclosed; or with special type lenses as illustrated. This means surface-brightness to the degree desired. Economical operation and high light values are outstanding features of the NEW HORIZON. . . . Ask for catalog that illustrates and describes this and all LEADER fluorescent fixtures.

## **NEW HORIZON**

### **Troffer Series**

**NHTHL-12-380 Slimline Troffer  
with Curved Holophane™ Control Lens**

## *Here's Beauty that Pays Off in Profits!*

● To retailers, a completely beautiful lighting effect is one that results in increased sales. The Lawton Jewelry Store, Orlando, Florida, finds beautiful Leader New Horizon fixtures charmers by this standard! (Fixtures used in the Lawton installation, illustrated above, are Leader's NHTHL-12-380). Leader's NEW HORIZON Slimline Troffer incorporates the multiple advantages of Slimline lamps and blends in elegantly with modern decorative developments. It is widely used for offices and public buildings, as well as for shops. . . . Don't fail to fully explore the possibilities of this tremendously popular fixture.

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Holophane Co.



*Sold and installed only by the better  
electrical wholesalers and contractors*

*America's No. 1 Lighting Equipment Manufacturer*

LEADER ELECTRIC COMPANY • 3500 NORTH KEDZIE AVENUE • CHICAGO 18, ILLINOIS  
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Campbell-Leader, Ltd. • Brentford, Ontario • Canada

## The Road Ahead

continued from page 35

war, the industrial job required will make the efforts of World War II look puny by comparison.

**IS THERE ENOUGH POWER?** For now—yes. We can ration and curtail non-essential use. For the long term—maybe not. Nobody knows yet how much we shall need. It may be possible to hook the war program onto the current power development program.

**THE PRESENT RATE** of production of generating equipment is 500,000 kilowatts a month. And under acceleration such equipment can be turning out power in a few months. A continuation of their rate of production could fill almost any possible power requirements in the foreseeable future. Further, war requirements are usually around-the-clock and can take a great many more kilowatt-hours of power from existing capacity. Look for some development of isolated generation, even at moderately higher kilowatt-hour costs, where plants have great strategic value. The needs of war production are not so much a matter of higher peaks as of round-the-clock utilization.

**WIRING MATERIALS** will be progressively more scarce in the months to come. After the inventory shake-out of 1949, stocks in the hands of distributors, wholesalers and contractors remained at a relatively low level. The very rapid acceleration of construction activity since April of this year has pulled down inventories still more.

**FROM THIS LOW INVENTORY** level will be drawn an increasing amount of urgent and essential requirements for industry. The intelligence and speed with which these needs are met voluntarily will have a lot to do with when and how much control will be imposed.

**TO MAKE VOLUNTARY** effort effective, two specific forms of legal protection will be needed 1) Relief from existing contract liability as the result of diverting materials and manpower to essential use, and 2) Relief from prosecution under the Anti-Trust laws for inventory pooling and similar joint efforts in the national interest.

**WHAT CAN WE EXPECT?** The initial procurement program is about 20 percent of total war effort. This will mean a reduction in normal civilian activity of about that much. That is, the military effort must be imposed upon an already full economy.

**BUT THIS IS ONLY THE BEGINNING.** Look for allocations of steel, copper, aluminum, zinc and some other materials. Look for important reconversion of major industries shortly thereafter. You will find electrical materials progressively more scarce, not from production cut-back but from accelerated demand. Production cut-backs are still in the future since, if and when the big war construction job breaks, maybe next spring, we'll need very large quantities of wiring materials.

**CONSTRUCTION CONTROLS** will probably not get under way until well into next year. The machinery, however, will probably be organized long before. Materials control, on an end use priority, will be in full swing sometime next year.

**FOR ELECTRICAL CONTRACTORS**, the course of events would warn against diving for cheap work. The escalator clause ought to be brought back to lump sum bids as it is going to be increasingly difficult to get firm material quotations for future delivery. Close liaison with industrial customers is in order.

*William T. Stuart*



## How to keep customers "POWERFULLY" HAPPY!

### Get G-E Motors via Graybar

On any power-drive order, to get the most for your customer's motor dollar every time, make sure you specify G-E motors via Graybar. No matter what your customer's requirement, Graybar can provide the motor that's exactly suited for the job. Graybar distributes the full line of G-E motors—the motors that both plant and product engineers accept without question for any installation. AC or DC, general- or special-purpose—dependable GE motors deliver the power you want, smoothly and steadily, for long periods without maintenance.

### All the Right Controls

To keep your customer's G-E motors "under control", team them up with G-E starters. In addition to full protection against injurious overloads, they have other security built-in. All live parts are completely enclosed . . . contacts and other operating parts have long-life features. Cases have ample conduit knock-outs and terminals for easy installation. With the same order from Graybar you can obtain all the right wire, conduit, and accessories for your motor installations.

### "Powerful" help on all power needs

Throughout the nation at 19 of Graybar's 105 offices, there are Power Apparatus Specialists who are highly experienced in the selection and application of motors and controls for specific tasks. The nearest Graybar Specialist is ready to help you survey your customer's plant to plan the best use of all kinds of power equipment—including transformers, switchgear, circuit breakers, capacitors, and other items for intra-plant distribution. Altogether, Graybar distributes more than 100,000 electrical items. For dependable supplies . . . for help in speeding lighting, communication, ventilation, and other electrical installations, call our nearest office. *Graybar Electric Company, Inc. Executive offices: Graybar Building, New York 17, N. Y.*

### FREE—two booklets on Controls

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# How To Estimate Electrical Work—VII

How to use the six major "operators" which adjust standard labor units to practical job conditions.

By W. T. STUART

**L**ABOR units usually express the "standard" time for the installation of a certain item or unit of material. In most tables or manuals of labor units used by electrical estimators, the units are bare. They represent average time under the best conditions; normal job manning, adequate supervision, good working drawings, simple layout, materials at hand as needed, immediate and unobstructed access to work areas, efficient deployment of men over the job and a minimum of interruptions.

If the units are reasonably accurate for such relatively ideal working conditions, they will be too low for the more complex work under not-so-ideal conditions. Remembering that our "units" actually represent a range of values, each may be adjusted upward to meet other conditions. Such an adjustment of each unit is too complicated and tedious for practical estimating. The adjustment is made more effectively by analyzing the job under consideration and applying "operators" or "job factors" to correct the standard time for the conditions to be expected.

Without operators, in the writer's opinion, labor units have little practical value. Labor units can be so adjusted that they represent "average" conditions. But a study of the operators

will show that there are practically no average jobs, and that normal variations from average conditions can be critically important to labor costs.

## *The Six Operators*

There are six major operators used by estimators to adjust labor-hour figures developed by the use of "standard" or normal labor units to specific job conditions. Each is based on a set of conditions which can influence a certain area of the labor cost.

Standby  
Weather  
Size  
Coordination  
Complexity  
Efficiency

On many jobs, particularly at the beginning of construction, sleeves, outlets, support bolts and similar details may be required long before major roughing-in operations can be started. Installed work must be checked, guarded and adjusted while concrete is poured or other structural work is in progress.

It is impractical to tie the labor cost of such work to the items of material installed. Yet the standby time is essential to the effective execution of the work. It will vary in terms of the specific job requirements and has little or no relationship to labor units. This operator may be a small percent-

age of the roughing-in labor total. The more practical adder, however, is a lump sum of labor hours based upon experience with like standby requirements on other jobs. The amount is entered as an item on the branch circuit roughing pricing sheet.

The effect of adverse weather conditions on electrical work varies considerably over the country. Some work is pushed ahead regardless of weather, with inevitable lower productivity during extremes of heat or cold. Frequent stoppage and standby while payrolls go on can become significant to labor cost. Job experience will disclose how much lost time or decreased productivity can be expected, and an appropriate operator applied to the labor affected. The size of the project can have an important influence on roughing costs. On a multi-story concrete structure of small floor areas, there are interruptions while forms are erected, during which electrical work cannot proceed efficiently. The operator to be applied depends upon the effect of such interruption on installation labor costs. The affected work is usually the branch circuit roughing. The percentages to be added are given in the table. The areas are foundation areas.

Where work may proceed on a schedule or roughing crews can be effective

## OPERATORS

In this article on the use of "operators" or "job factors", we are in a controversial area. Many estimators do not use them, claiming they are too complicated. These estimators show accurate estimates made without them to prove the point. We argue that these estimates contain items of "non-productive labor" and "contingencies" which perform the function of operators. We feel that a set of operators is essential to accurate estimating and they will be used in this series of articles. Discussion is most cordially invited.

tively deployed on other work, the size operator is not used.

Cooperation from other trades and the over-all coordination of the work play an important part in achieving efficient labor productivity. On slab work where the concrete buggies are wheeled in on the heels of the reinforcing steel, electrical work has to be inefficiently over-manned. Or slow form work may keep electrical crews at standby. Some generals give the subs full cooperation and the subs participate in advance job scheduling. Others treat their job schedules as top-secret and give the subs virtually no advance information.

From experience with generals and other trades, the estimator can appraise with considerable accuracy what influence these particular methods will have on his labor costs. This operator is usually expressed as a percentage and applied to the branch circuit roughing since this part of the work is most sensitive to job coordination.

Some jobs are simple, require little study time, and only occasional references to working drawings; other projects are complicated, with many circuits in a small area, or require close alignment with structural features. Obviously, even though the same materials are installed in the same way,

the more complex work takes more time per unit of material.

To adjust for such conditions, we have the complexity operator which is usually applied to the branch circuit roughing. It is important to note, however, that this operator should also be applied to feeder work where large concentrations of conduit runs must be worked into limited space.

The efficiency operator is the most important. It converts "standard" time to fit the practical job experience of the individual contractor and the skills of the men available for the particular job.

Using 1938 experience as 100 (which has been established by Ashley as a bench mark for labor productivity) and assuming that our labor units are set at that efficiency, the average labor efficiency of each year since has been lower. This year's average productivity is about 80. To adjust a labor hour total based on 1938 standards to 1950, it must be multiplied by 1.25.

In use, however, the efficiency operator is fairly exact. At the completion of each job, the job estimate can be checked against the actual payroll and the amount of error noted and used to adjust the efficiency operator.

For example, let us assume a job estimate used an operator of 1.25 on a total of 10,000 hours standard or 12,500 hours adjusted. The actual hours turned out to be 12,000. Assuming like conditions on a job in prospect, we could figure it with an efficiency operator of 1.20.

The efficiency operator is applied to the total net labor hours on the summary or recap.

Example: To illustrate the use of the six operators, the following example may be used.

#### Branch Circuit Roughing Pricing Sheet

Operators	Ma- terial	Labor Hours
	1612	2140
Standby (lump sum)		36
Weather 1%		21
Size 6%		128
Coordination 5%		107
Complexity 2%		43
Totals	1612	2475
Summary or Recap Sheet		Labor Hours
Net		11,200
Efficiency operator + 10%		1,120
Adjusted		12,320

## OPERATORS

### Operators adjust standard or unit time to specific conditions.

#### 1. Standby

#### Add Lump Sum

Job manning for intermittent work which must be closely coordinated with the work of other trades. (Example—Mechanic assigned to job during foundation work to install occasional outlets, bolts for equipment supports, etc.)

#### 2. Weather

#### Add Percentage 0-20

Percentage added to affected work for interruptions involving standby time as a result of weather conditions. Usually a small percentage, often ignored, in ordinary work, it can be very important on certain types of projects, notably line construction.

#### 3. Size

#### Add Percentage 0-30

Percentage added to affected work to adjust for the size of the project. Small projects involve frequent interruptions, as between floors. Large projects permit continuous work. The size operator is usually applied only to the branch circuit roughing.

Foundation area less than 1,000 sq. ft.	30%
1,000—5,000 sq. ft.	15%
5,000—10,000 sq. ft.	7%
10,000—20,000 sq. ft.	3%
over 20,000 sq. ft.	0

#### 4. Coordination

#### Add Percentage 0-10

Percentage added to work affected by other trades, usually branch circuit roughing, to adjust for degree of cooperation to be expected.

Poor cooperation	10%
Normal cooperation	5%
Excellent cooperation	0%
Unknown	5%

#### 5. Complexity

#### Add Percentage 0-15

Percentage added to adjust for the study-time, layout time and supervision required. The following are typical:

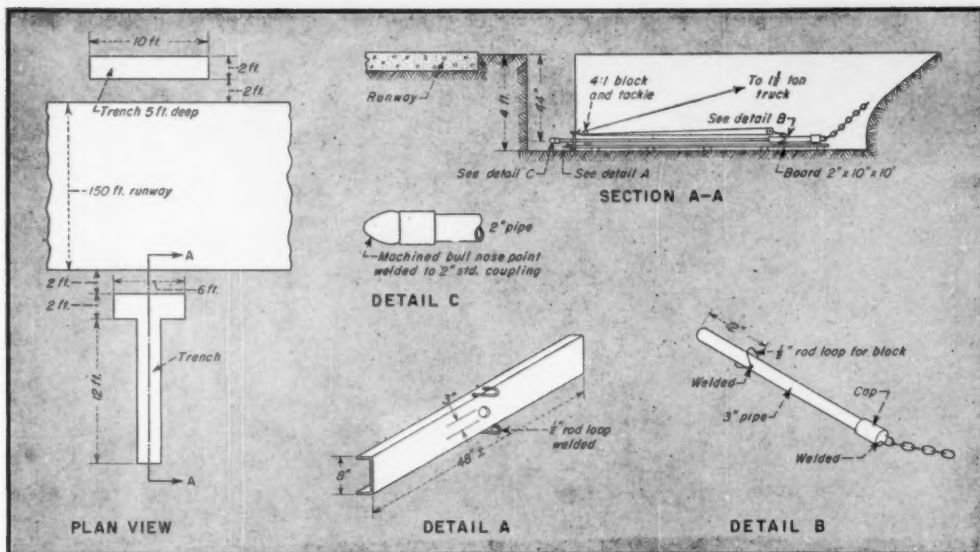
Warehouse	0%
Small store	2%
Residence	5%
Gas station	6%
School	8%
Church	10%
Industrial plant	12%
Laboratory	15%

#### 6. Efficiency

#### Percentage $\pm$ ?

Percentage added or subtracted from the total labor hours to adjust for probable productive efficiency of available manpower and management. This operator corrects the standard time to actual experience and current labor productivity.





**JACKING CONDUIT** under Wichita (Kansas) Municipal Airport runways was made easy, saving time and money, by

using a new speedier method outlined above. Only two workmen were required. Working conditions were safer.

## Improved Way to Jack Conduits

New speedy method for jacking conduits was used by Shelly Electric Co., Wichita, Kansas, to install 1000 feet of conduit under runways at Wichita Municipal Airport

**H**UNDREDS of airports—commercial, military and private—have been built during the past several years having many miles of paved runways, taxiways, aprons and other paved areas. However in most cases ducts were installed under runways and taxiways at intersections and other locations for the future installation of runway lights, wind indicators and possibly taxi lights; also other light and signal systems envisioned at the time the airports were designed. Practically every airport construction job today which involves work in the field, necessitates the running of light, power, communication or electronic landing aid circuits underneath these paved areas.

Today, high intensity and elevated medium intensity runway lights are gradually replacing the old semi-flush type contact lights. Where a single series circuit was all that was required for most runways in the old installations, now with some types of high intensity lights, three complete circuits

By Robert C. Blatt

are required for each runway. Taxiway lights are becoming more and more in demand. Lighted directional signs for taxiway intersections are coming into use. High intensity approach lights, ILS (Instrument Landing Systems), radar, etc., are being installed and scheduled for installation at most Air Carrier Airports.

In many cases, where ducts were installed under paved areas at the time the paving was installed, they are now unusable—due to breaks, settlement, pavement failures, obstructions, etc.

In some cases, ducts were installed for future use, but were left unmarked or improperly marked—so that it is now impossible to locate them.

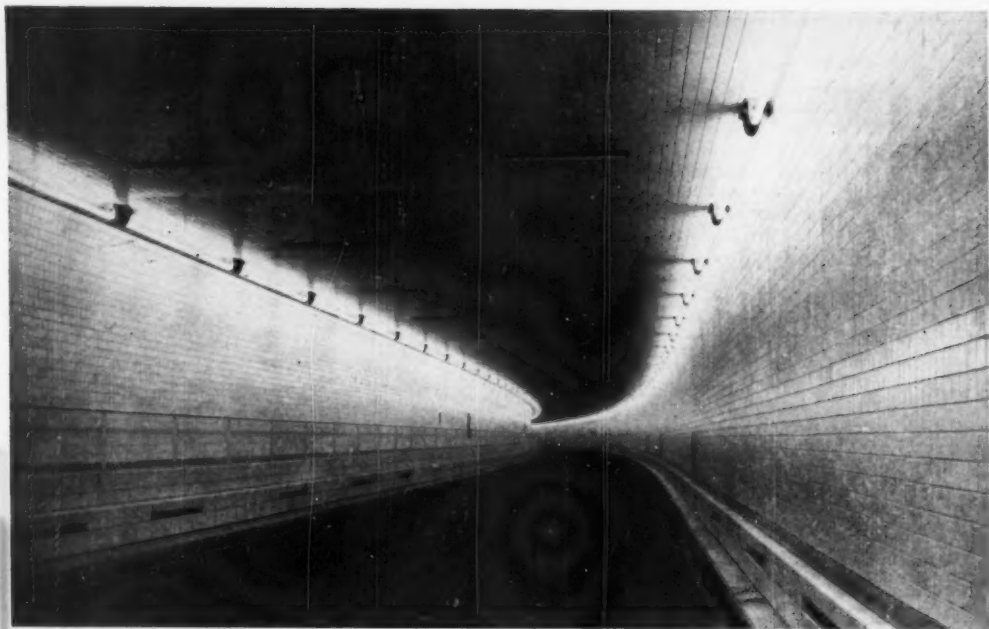
Since the cutting or breaking of these paved areas, for the installation of ducts is almost always strictly prohibited on airports, for reasons of safety, the electrical contractor's big-

gest headache usually is the "jacking" of protective steel conduits under these paved areas.

The new method described and illustrated here is both speedier and cheaper than the conventional mechanical and hydraulic jacking method generally used at airport installations. It was used on the Wichita Municipal Airport project by Clyde Whitchurch, Superintendent on the job for the Shelly Electric Company of Wichita, Kansas for the installation of electrical circuits for the Instrument Landing System under the runways at a number of points.

The only equipment necessary is illustrated and the procedure is as follows. On one side of the runway, a two-foot by ten-foot trench, about five feet deep, is dug—two feet away from the side and parallel to the runway. This trench is necessary for any conduit jacking method used, in order to locate the jacked conduit or pipe. On the opposite side of the

(Continued on page 62)

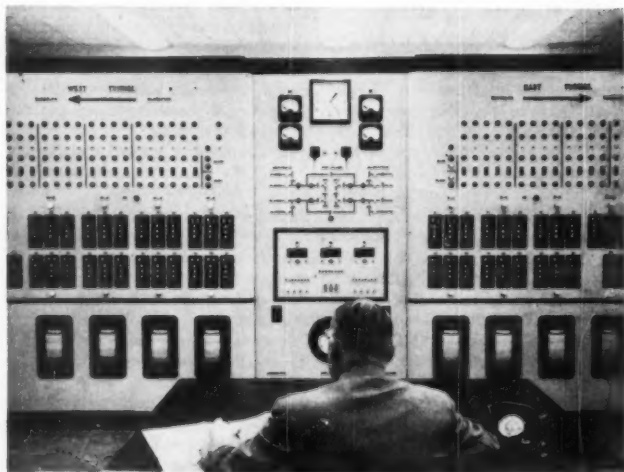


**BROOKLYN-BATTERY TUNNEL**, longest in U. S., is continuously lighted by slimline fluorescent lamps enclosed by Pyrex carriers. Tiled walls hide extensive wiring for power,

light, signalling and communications. Fresh air is introduced to roadway area through curb-line vents and exhausted through ceiling openings.

## Electrifying BROOKLYN BATTERY

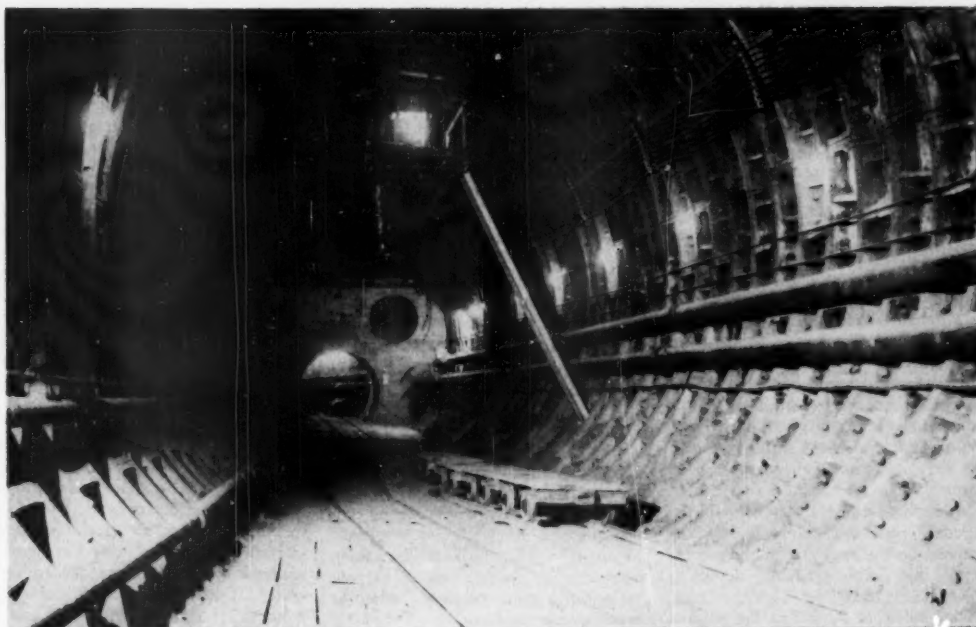
By Hugh P. Scott



**MAIN CONTROL SWITCHBOARD** permits constant monitoring of ventilation, lighting and traffic conditions. Remote regulation is possible through push-button controls. Over 1700 miles of wire link control board with the controlled components in the tunnels, entrance plazas and associated services.

**N**EW YORK City's recently-completed Brooklyn-Battery vehicular tunnel—an \$80-million project with an \$8-million electrical component—is an example of a tough, dangerous job well done. Started a decade ago, discontinued for three years during the war, and opened to traffic by the Triborough Bridge and Tunnel Authority on May 25th of this year, it measures 9117 feet from portal to portal (longest in the U. S.) and will handle an estimated 16-million cars a year.

Coordination of effort was a tremendous job, for the tunnel project was completed under 21 separate contracts involving simultaneous work on two shorelines and a man-made island in New York Bay as well as in the tunnel proper, 20 fathoms below water level. Electrical work alone was executed under six contracts and a 310-page specification, covering the in-



**DURING CONSTRUCTION,** temporary wiring mounted on cast-iron walls carried 440-volt power for muckers, hoists and pumps. Local transformers stepped current to 110-volts

for lighting. Concrete bulkhead, with locks for a row-gage railway, materials and men, was sealed during period when compressed air was in use.

## TUNNEL

**Contracts totalling \$8-million, covering the supply and installation of wiring, switchgear, lighting and electrical equipment, were of major importance in the completion of America's newest and longest vehicular tunnel.**

stallation of temporary and permanent distribution systems, ventilating and pumping equipment, electric heat, communications, fire and carbon-monoxide alarm systems, traffic control, transformer equipment, control and illumination. Each phase of the work was complex in itself with men working at times from barges in the bay, in the muck of the river bottom and under compressed air.

### **Slimlines Illuminate Tunnels**

Illumination for the Brooklyn-Battery tunnel is unique, for it is the first time that fluorescent lighting has been used in "subaqueous highway" applications. And results are excellent; for critical brightness control is possible for the continuous lines of light; walls and pavement are evenly illuminated; dark scallops along the upper walls between luminaires are eliminated, and disturbing intermittent

highlights on windshields and hoods of moving vehicles (experienced under spaced incandescent units) are completely absent. Another practical consideration is economic, for, although first costs are higher, the annual kilowatt consumption is only one-seventh that of comparable incandescent installations in other metropolitan vehicular tunnels, according to Leo Geenens, electrical engineer for the Tunnel Authority.

Mounted on the 13.5-foot ceiling, 6 inches in from each tiled sidewall, the parallel continuous fluorescent installation consists of 6-ft. T-8 standard warm white G. E. slimline lamps housed in clear 2.5-inch O. D. Pyrex tubing. In all, there are approximately 3000 of these Pyrex tubes, each 12-foot section enclosing two slimline lamps. Cast bronze housings, surface-mounted on tunnel ceilings, serve the dual purpose of supporting these tubes and

enclosing the necessary 2-lamp series transformers.

Installation of the heavy bronze housings was greatly facilitated through the use of a special lifting rig, consisting of a cradle for supporting the housing, a vertical ratchet channel, a gear crank, and spring-held dog to prevent slippage. In operation, the housing was placed in the rig cradle, lifted into position by hand-crank action, and bolted into position. Two rigs, mounted to the top of each rolling scaffold used for installation purposes, were erected on 12.5-foot centers so that two bronze housings could be lifted into their proper positions simultaneously. Compared with all-manual installation, savings in effort and time were considerable.

The use of 12-foot Pyrex tubes achieves three objectives; protecting the lamps from damage due to flapping and slapping tarpaulins on pass-

ing trucks, permitting maintenance crews to wash the tunnels with high-pressure hoses, and facilitating maintenance by halving the required number of sockets. Replacement of lamps is from the top of a specially-designed maintenance truck, equipped with a protected working platform and having a liberal supply of spare tubes and replacement parts. Individual lamps are not replaced, for time can be saved by installing a pre-assembled 2-lamp tube assembly, with testing and assembling completed prior to each maintenance check-up.

Wiring of lamps is a variation of conventional series street lighting, for customary constant-current station transformers are replaced by saturable core reactors. By varying reactor dc, the current in the series lines can be regulated and lamp output can be controlled as desired.

Illumination levels vary through the tunnel, with approximately 4 foot-candles on the roadway for the greater part, and with gradually-increasing levels for 1825 feet at either end, rising to about 20 ft-c at the portals. This is accomplished by controlling lamps in groups, with corresponding currents capable of being varied from 50- to 450-ma, depending upon the requirements of outside lighting and temperature conditions. In effect, this results in a combination of hot- and cold-cathode operation. Brightness values are constantly monitored by photocell units, while current is remotely regulated from the lighting

switchboard on the Brooklyn shore, either manually or by astronomical clocks. After dark, when natural outside lighting is absent, the entire tunnel is illuminated to the 4 ft-c level.

Lighting current is taken from both the Manhattan and Brooklyn utility networks (two circuits from each shore running completely through each tube) and the 208-volt 3-phase service is transformed to an operating level of 2400-volts through eight 100 kva transformers. Groups of lamps are staggered between the three phases of these eight circuits so that, even if one utility network completely failed, lighting in the tunnel would remain continuous.

#### Mercury Vapor Plaza Lighting

Both the Manhattan and Brooklyn plazas are illuminated by ornamental lighting standards, both wall- and pole-mounted, supporting either one or two pendant-type 400-watt mercury-vapor luminaires. Transformers for lamp operation are confined either in pole bases or in concrete niches adjacent to the standards. Lamps are Type FH-1, 16000 lumens, T-16 clear, base up burning. Light distribution from each luminaire is asymmetrical, with maximum candle power directed 17 degrees below the horizontal and aimed slightly in the direction of traffic to minimize glare from lamps disturbing drivers approaching the tunnel portals.

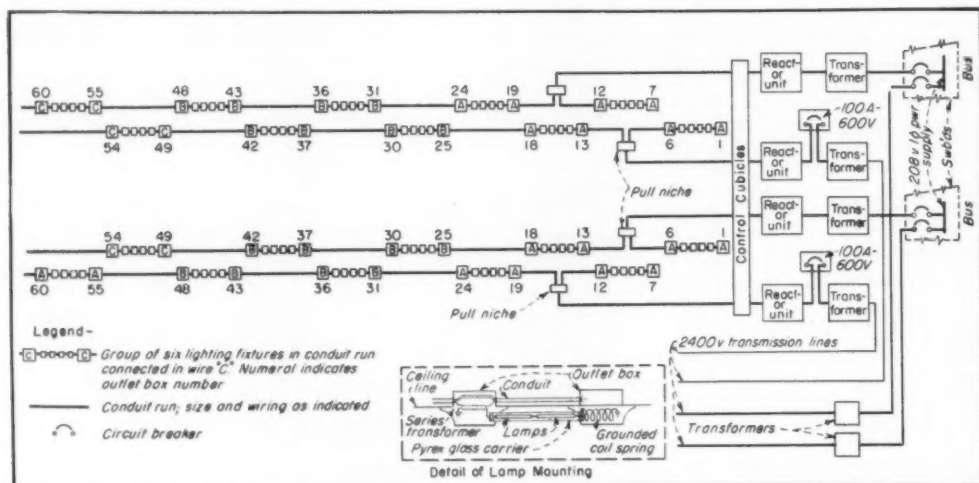
#### Fluorescent and Neon over Toll Lanes

For lighting the 12 lanes of traffic

passing between the toll booths located in the Brooklyn plaza, 72 slimline fluorescent fixtures are recessed into the continuous booth-protecting canopy. Fixtures are 4-lamp units, equipped with thick polished plate-glass covers, gasketed with soft rubber to retain lamp heat within the air-tight enclosure during cold weather. Lamps are 72-inch single-pin T-16s, operating at 200 ma. Six fixtures are installed above each traffic lane, arranged in two 3-unit rows so that eight 18-foot lines of light illuminate these areas. Lamps are controlled by three circuits so that the artificial light output can be half-, three-fourths-, or full-capacity to compensate for graduations in daylight intensities and variations in lumen output due to temperature changes.

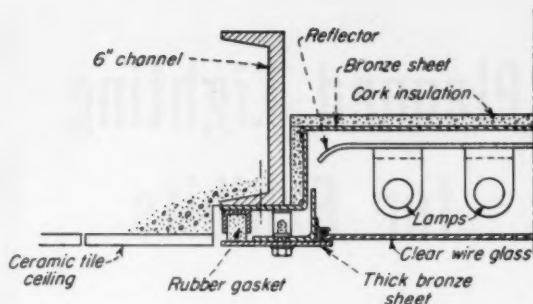
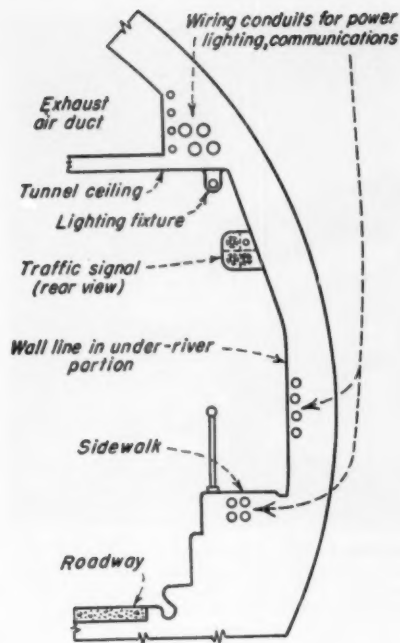
Also installed above each traffic lane are two bronze-housed indicators capable of flashing any number from zero to nine in large red neon characters to visibly verify the correct recording of vehicle classifications. For maximum visibility, neon numerals are operated at half voltage and half brilliancy after dark, with voltage automatically reduced by astronomical contact-making clocks, triple-pole transfer relays and auto transformers.

Neon classification indicators are activated by toll booth attendants collecting fees and registering, on a motor-operated printing tape, the classification of each vehicle passing the booths, lane numbers, date, time and direction of traffic. Power for operating all toll equipment is single-



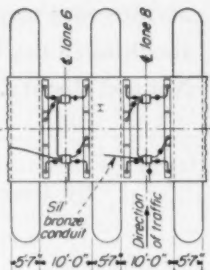
**FOUR THREE-PHASE CIRCUITS** extend from portal to portal, permitting 12 wiring combinations to insure continuity of

illumination. Each outlet box has a series transformer for operating two slimline lamps carried inside Pyrex tubes.



**TOLL LANES** are illuminated by 4-lamp slimline fixtures (6 per lane) recessed in canopy above toll booths. Thick glass covers and rubber gaskets confine heat of lamps within enclosures during cold weather for efficiency. Canopy also holds indicators connected with toll-tabulating machines.

**CROSS SECTION** through tunnel indicates location of lighting fixtures, traffic lights and conduit for carrying power, lighting, signalling and communication wiring. Roadways are 21-feet wide with 13.5-foot clearances.



phase 60-cycle ac with grounded neutral, and ungrounded 60-volt dc.

#### Electric Eyes Detect Overheight Vehicles

In order to automatically detect vehicles having heights greater than tunnel clearances, both approach roadways are spanned by photo-electric beams of light which, when interrupted, activate relay-controlled warning horns for the information of traffic officers stationed at the portals. In addition, interruption of the beams automatically changes traffic signals from green to red. Convenient reset buttons are provided for silencing the horns and changing the lights back to green after the overheight vehicle has been spotted, halted and diverted from the tunnel approach.

Light-beam distances between lanterns and phototubes are approximately 100 feet in length, yet adjustments are sufficiently sensitive to detect a 5/8th-inch rod passing the beams at a rate of 30 mph.

#### Ventilation

Flow of fresh air to the tunnels and the removal of exhaust fumes is regulated by 53 motor-driven damper mechanisms (26 exhausts and 27 blowers) variously located in two shore and one island-based ventilation

buildings. Normal maximum air supply is 4,150,000 cfm, or 42 complete changes an hour. In accordance with existing general practice, fresh air ducts are located beneath the roadways, with supply ports located just above curb levels. Exhaust ducts are above the driveway area, with exhaust openings in tunnel ceilings.

All fan motors are totally enclosed squirrel-cage induction units, designed to operate at 1200 rpm. on 3-phase 60-cycle 208-volt circuits and to develop up to 850 pound-feet starting and running torques. Each fan (backward curved horizontal centrifugal) is connected to one single-speed and one two-speed motor. The single-speed unit is connected by chain or flexible coupling and drives the fan at full speed. The 2-speed motor is chain connected and operates the fan either at 1/3rd or 2/3rds full speed so that, by using various combinations of fans and motors, air supply can be controlled from 20- to 100-percent of capacity in eight steps. Largest fan motor in service is 392-rpm. 275-hp. unit.

Fan operation is remotely controlled by pushbuttons on the main control board in the Brooklyn service building. This board, "the brain" of the electrical system, permits exact control of ventilation and keeps concentrations

of carbon monoxide below the ultra-safe level of 2.5 parts in 10,000 of air; less than that existing on many city streets. CO detectors, located at close intervals through the tunnels, continuously collect and relay air samples to an automatic analyzing station where a running record is recorded and where an alarm notifies the supervisor whenever the CO content of the tunnel reaches the established safety level. Periodic calibration of analyzing equipment insures accuracy of readings and motorist safety.

#### Control and Distribution

The main control board, in addition to controlling ventilation, regulates lighting, all traffic lights, and constantly indicates the status of the entire electrical system. This board, constructed by the General Electric Company, is the largest tunnel switching unit in existence. More than 1700 miles of wire link the board with the controlled equipment.

Power for the tunnel, approaches and associated services (alarms, pumps, elevators, vacuum cleaners, machine shops) is supplied through six G. E. switchgear units, two each in Manhattan, Brooklyn and the Governors Island ventilation building. Primary power at 208 volts is trans-

(Continued on page 123)



# Planned Lighting for Exhibits

Controlled lighting is integrated with architecture to provide ideal display facilities in the Utah Field House of Natural History.

By Laurence E. Baty  
Electrical Engineer  
Salt Lake City, Utah



**COVE LIGHTING** from cove concealed in ornamental trim at top of wall cases lights murals and wall mounted paintings in the Utah Room. Two rows of 20 mm. white neon tubing, operated at 60 ma., are installed in the cove.



**LUMINOUS SKYLIGHTS** in wall cases, and combination fluorescent-incandescent luminaires ceiling suspended, provide ideal lighting for natural history museum exhibit at the Utah Field House of Natural History, Vernal, Utah.

**T**HE Utah Field House of Natural History, located on U. S. Highway 40 in Vernal, Utah, has been opened recently. Sponsored and built through the efforts of the Department of Publicity and Industrial Development, State of Utah, it is used to display the salient features of the two-billion-year rock-record of the Vinta "mountain" range in Northeastern Utah.

Peaks of this range rise more than 13,000 feet above sea level, in which all known geologic eras appear in 26 major formations of varying thickness.

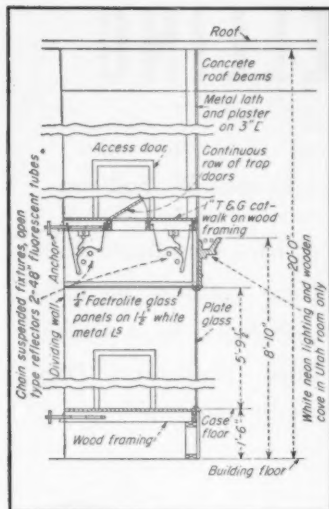
The Utah Field House is constructed of brick and concrete. Designed by Miles E. Miller, Salt Lake City architect, it is 130 ft.-6 in. long by 96 ft.-4 in. wide, single story, with-

out basement. The design is such that a 6200 sq. ft. central area is for exhibit purposes, and a 15-foot wide outer area, which contains the various service facilities, surrounds the exhibit area. The central area is divided into three exhibit rooms, each with a 20-foot high ceiling. In each exhibit room illuminated display cases approximately eight feet high surround the room. In the service facilities area, the ceiling height is 13 feet, and the area includes such rooms as a laboratory, library, study, office, as well as the work, storage, fan and boiler rooms.

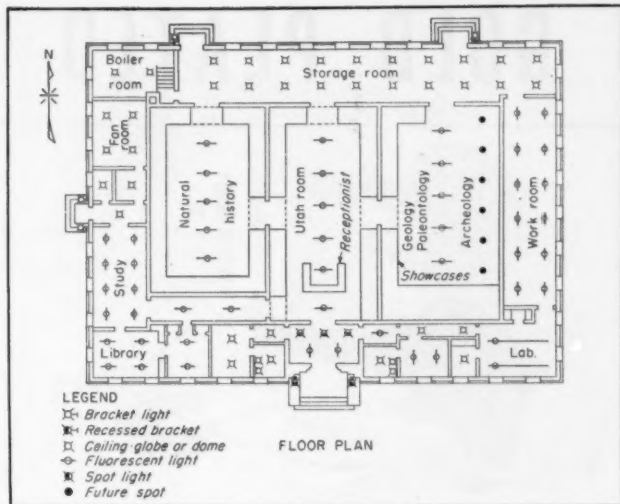
Planned lighting is a prime feature of the exhibit areas. Both fluorescent and incandescent lighting are used throughout the building, and in the exhibit areas these light sources are in some instances combined in single units.

The entrance lobby is illuminated by two 4-lamp fluorescent luminaires of the general diffuse type. This lighting is supplemented by three 150-watt R-40 lamp, adjustable hooded units which focus attention to a wall inscription: "A knowledge of the past makes understandable the present and serves as a guide to the future".

Lighting for the classroom, library and office, located in the perimeter service area is supplied by 4-tube fluorescent luminaires having diffusing glass bottoms and sides, and sus-



**FLUORESCENT LAMPS** in open type industrial reflectors installed over panels of Factrolite diffusing glass light wall display cases to 65 footcandles.



**THREE EXHIBIT ROOMS** are provided with general lighting by combination fluorescent-incandescent luminaires. Exhibit area is surrounded by service facilities rooms using conventional fluorescent and incandescent lighting, including research brackets at entrance.

pended by twin-stem hangers. The classroom has eight units on 7-ft. by 10-ft. spacing. The library has four units in a 10-ft. by 10 ft. arrangement. Two units are used in the office. Rest rooms and public corridors are lighted by 2-lamp fluorescent units, while minor service areas are lighted by incandescent enclosing glass units of 100 and 150 watt sizes.

In the laboratory and work room areas 2-lamp industrial reflector type fluorescent units are used. Fixtures in the laboratory are installed in continuous rows, while units in the work room are individual types.

The lighting technique used in the three exhibit halls consists of local overhead lighting for the wall cases, and provides general lighting from a row of individual combination fluorescent-incandescent luminaires suspended from the 20-foot high ceiling in each hall.

In the central exhibit hall (Utah Room), murals and pictures installed on the walls over the top of the display cases are lighted by two rows of 3500-degree 20 mm. white neon tubes operated at 60 ma., concealed in the wood cove at the top of the cases, which forms a part of the building trim 8 ft. 10 in. above the floor.

In the Geology Room (east exhibit hall), a painting approximately 50 feet long by 18 feet high, showing a cross-section of the 100 mile geological for-

mations in the Vinta mountains, will be illuminated by six swivel type floodlights installed on the ceiling.

General illumination in the three exhibit halls is provided by luminaires suspended from the 20-ft high ceilings at a height of 14 feet from the floor. Six of these luminaires are installed in the central exhibit hall, and five luminaires of the same type are installed in each of the other two exhibit areas. Each luminaire consists of a louvered 4-lamp 4-foot long fluorescent section, each end of which is fitted with a two-lamp louvered 150 watt R-40 reflector spot housing. These spots may be turned in any angle up to 45 degrees from vertical, and are for use in lighting up room center exhibits. Illumination intensities up to 55 footcandles are available for such floor exhibits.

The outstanding feature of the lighting is the local lighting in the wall display cases. These cases are all set against the partitions. A lathe and plaster subpartition is carried up from the case fronts to the ceiling and serves as a mounting for murals and pictures, as well as to conceal the maintenance catwalk.

All cases are 4 ft.-6 in. deep, except one in one end of the Geology Room, which is ten feet deep. All have a usable height of 5 ft.-9 in. The showcase and intervening arch tops are artificial skylights, formed of 4-in.

Factrolite diffusing glass panels supported by 1½ in. angles. The wood floor of the catwalk is about 2½ ft. above the skylights and has a continuous row of trapdoors down the center.

Two runs of conduit are attached to the bottom of the catwalk in each case. Outlet boxes and receptacles are cut in on 53 in. to 58 in. spacing. Lighting units of the two 40-watt fluorescent lamp type, with open end industrial reflectors, are chain suspended from the catwalk framing and are electrically connected to the outlet receptacles by individual flexible cord connections. A total of 168 units are used to light the 1920 square feet of cases and arches. Each case is switched as a unit. Reflectors are used both at the front of the cases and at the back, and provide a maximum lighting intensity of 65 footcandles.

Access to the catwalks over the cases is obtained through openings from the storage room. The showcases may be entered from the storage room and the front halls.

All lighting equipment used on this project, both fluorescent and incandescent, were Westinghouse Electric Corporation units.

The general contractor on this project was Dorland Construction Company of Salt Lake City. Total cost of construction was \$195,000. The electrical work was subcontracted for \$13,608 by Oberg Electric Co.

# GOLD PLATED SELLING



**BAXTER'S BUSINESS** was blowing out the window as a result of price competition.

**T**HE Baxter Electric Construction Company was losing too many lighting contracts to price-cutting competition. It had happened three times during the last month and, from the look of things, would keep on happening. It seemed as if the return of normal, tough selling conditions after the lush war days had made many competitors panicky, and they were using price as the only basis for getting jobs. Contracts in this Eastern seaboard city were going at ridiculous figures.

Bob Baxter, (which is not his real name), had always refused to compete on this basis, and he refused now. But a glance at his "Jobs Lost" column told him that he would have to find some better way to land contracts if he was to stay in business. He found the way.

This is the true story of how Baxter lost a \$1,000 lighting job to a price-

cutter and then regained it with a proposal which cost the satisfied client ten times the amount of the winning bid. Yes \$10,000! How did he do it? Simply by the use of common sense selling methods which always work.

We'll call his client Sam Iverson, a long-established jeweler, who had decided to meet current conditions by improving his store. The principal part of the job was the lighting contract which involved rewiring and the replacement of all the old fixtures in line with modern planned lighting methods.

Bids were asked from a number of contractors, and the usual price-cutting rat race was on. Starting at about \$1500, the price was chipped and chiseled down to \$1,000, at which figure the winner would be working for fun.

Baxter's bid was high, and when the figures leaked out he knew he wouldn't get the business. In fact, he told himself wryly, his competitors had already "given him the business". That was when he decided that something would have to be done. An idea struck.

The next day when the salesman from his fixture manufacturer dropped in, Bob Baxter asked him one question, a question which turned out to be worth \$10,000.

What happened? Baxter quit thinking about how anxious he was for the order and began thinking about his prospect, whose store and business he knew well. Clearly, Iverson was

By  
**Francis W. Sullivan**

**A sales consultant illustrates selling methods that work in a typical sales problem. They could work for you.**



**GOOD LIGHTING** in a jewelry store ought to pay for itself.

the last man in the world who should buy strictly on price. In fact, very few people bought strictly on price. Otherwise, the Iversons would be driving around in 4th hand automobiles, wearing shoddy clothing and rolling Bull Durham cigarettes. Instead, they bought new Buicks, brand-name suits and tailored smokes.

Why? Because these better articles satisfied certain needs and desires better than the cheap ones could do.

Take himself, for example. He had paid \$75.00 for his Sunday suit because he wore it to church and wanted to be as well dressed as his neighbors. His pride and sense of "belonging" needed their approval.

His wife had chosen the refrigerator in their kitchen because it provided certain features of convenience, food protection and labor saving which made her work easier. That was her need. The box which gave her these satisfactions was not cheap.

When he bought merchandise for his business, he had one chief need—to make money. But experience had long



**GOOD SELLING** means that you satisfy people's needs.

since taught him that price alone wouldn't always insure that. Certainly, price didn't decide on hacksaw blades or pipe machinery. And other needs entered into his buying; his standing as a merchant, and the satisfaction he got from giving a little more on every job than his bid called for.

So, people bought things to satisfy their particular needs! What about Sam Iverson, the jeweler? What were his needs? Baxter slowly thought out Sam's needs and wrote them down. His store must continue to be the best jewelry store in town. The store fittings must be in keeping with the type of high quality expensive merchandise he sold.

The appearance of the store, due to its lighting, must help sell more goods. It must keep his old customers and draw new ones. It must give each one the feeling that here were the proper surroundings in which to select at leisure articles which would last a lifetime. In such an atmosphere, more people would buy—and buy more.

Good selling meant that you satisfied people's needs.

How could he satisfy Iverson's needs? The more he thought about it, the more he saw that the lighting and the fixtures were the answer. That's why this contract was so important. The light itself must be soft, but clear, both overhead and in the display cases. Light values and location must be scientifically chosen. And the fixtures must harmonize completely with the richness of the surroundings.

So that morning when his fixture



**BAXTER ASKED** the fixture manufacturer's salesman one question. It turned out to be worth \$10,000.

salesman came into the store, Baxter opened his catalogue to a certain page and threw the \$10,000 question. "Could you people make up this number finished in genuine gold plate?", he asked, and outlined the sales plan he had in mind.

The salesman reeled to the telephone and called his factory which, later in the day, wired an affirmative reply. Then Baxter made an appointment to call on Iverson; but before he went he laid out his sales presentation carefully in advance.

During the interview, he talked of nothing but Iverson's interests, how he and his business would benefit from the suggested plan. He appealed to

Iverson's pride and prestige. He showed how beauty in the store, combined with customer convenience, would result in greater sales and profits. He showed how his proposal represented an investment in the greater future of the store, which would pay for itself out of earnings.

In short, he satisfied completely the deep-rooted needs which had caused Iverson to call for bids on the job in the first place.

The cost of the work was not mentioned until the end, but so skillfully had Baxter presented his case that this feature had now lost any importance. Iverson took the \$10,000 in stride.

Every day contractors are bidding on jobs as rich in opportunity as Iverson's, and most of them are going to the chiseler with the sharpest pencil. Very few are sold on the basis of imagination and a plan. What Baxter did, any electrical contractor can do if he will take the trouble to employ sound principles of selling.

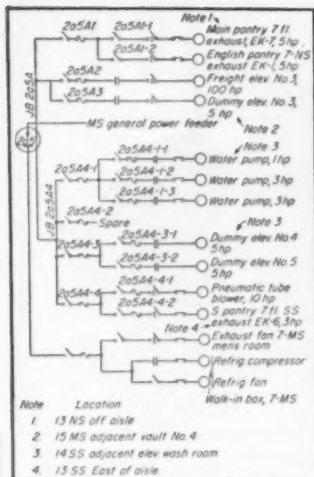
Profitable selling calls for skilled selling, and that starts with a common-sense analysis of why people buy things. Every job offered has sprung from definite, specific needs. Reason out what these needs are and line up a proposal which will satisfy them. In nine cases out of ten, price will turn out to be a secondary consideration. Any buyer's first consideration is the satisfaction of his needs in the most usable way.

You don't believe it?

Look around your stockroom, your office, your tools, and your home, and figure out why you bought the things you see!



**EVERY JOB** is rich in opportunity. Will it go to the chiseler with the sharpest pencil or on the basis of imagination and a plan?



**ONE-LINE CIRCUIT DIAGRAM** on 8½ x 11 sheet gives distribution details beyond first feeder take-off.



**LOOSE-LEAF RECORD BOOK** contains detailed single-line circuit diagrams and equipment data sheets that tie-in with master feeder plan. Records are compact, complete and can be quickly revised.

# Coded Records for Distribution Systems

Compact, coded record system for electrical circuits and equipment combines loose-leaf circuit diagrams with master plan; ties-in with equipment data sheets.

By Wilbur J. Fleig

Consulting Engineer, Chicago, Illinois

ONE of the specific requirements during a complete electrical system survey and feeder modernization in a large Chicago department store was the development of a flexible, permanent record system for equipment and circuits. Management wanted a system that would:

1. Be flexible enough to permit expansion of any part or all of the record by adding new data when occasion demanded.
2. Be complete—including all circuit and equipment information.
3. Permit easy revision of existing data as required by system alterations and additions.
4. Have a suitable cross-filing scheme for quick reference from a reasonable number of approaches.

5. Be adaptable to easy duplication of individual data sheets.
6. Have a circuit designation and equipment index that would provide a common tie between circuits and associated equipment both in the record and on equipment labels. Designations were to be fairly permanent, not easily affected by equipment changes, and flexible enough to accommodate system additions.

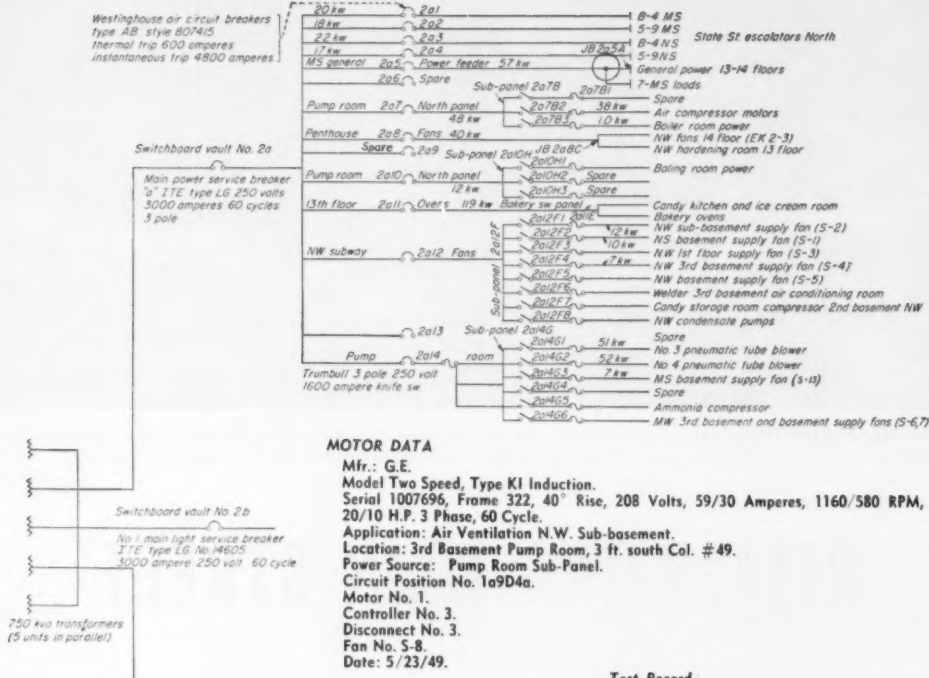
A loose-leaf record was the logical solution to this problem. As developed, the book contained detailed single-line diagrams of sub-feeders and branch circuits; plus individual data sheets covering equipment served. Data sheets included numbers indicating circuit position, controller, disconnect and motor indices together with name-

plate and test data.

To cover the distribution completely, and not make the diagrams physically unwieldy, two types were used. A master diagram was made for each bank of transformers and carried out to the termination or first take-off of the main feeders. This was a 24-inch by 32-inch tracing of which blue prints were issued to interested personnel and placed at corresponding main switchboard panel locations.

Beyond that point, detailed diagrams were made to show individual load connections. These were 8½-inch by 11-inch tracings, of which blue prints were entered in the loose-leaf System and Equipment Record book. Copies were also mounted at corresponding sub-panels and other points to facilitate maintenance activities. Thus, for





**PORTION OF MASTER PLAN** showing transformer substation, switchboard and main power feeders. Note circuit designations.

**EQUIPMENT DATA SHEET** from loose-leaf record gives full information on motor, control and disconnect; also any test data recorded.

#### MOTOR DATA

Mfr.: G.E.  
Model Two Speed, Type KI Induction.  
Serial 1007696, Frame 322, 40" Rise, 208 Volts, 59/30 Amperes, 1160/580 RPM, 20/10 H.P. 3 Phase, 60 Cycle.  
Application: Air Ventilation N.W. Sub-basement.  
Location: 3rd Basement Pump Room, 3 ft. south Col. # 49.  
Power Source: Pump Room Sub-Panel.  
Circuit Position No. 1a9D4a.  
Motor No. 1.  
Controller No. 3.  
Disconnect No. 3.  
Fan No. S-8.  
Date: 5/23/49.

#### Test Record

Current: A 67(25), B 64(24), C 61(23).  
Voltage: AB 200(201), BC 196(195), CA 197(199).  
KW 16.2(3.4), Power Factor 0.68(0.41).  
( ) = Slow speed values.

#### CONTROLLER DATA

Mfr.: G.E.  
Model CR7006 Spec., Type Pole changing magnetic switch, Serial L23EA260, 208 Volts, 75 Amperes, 20 H.P., 3 Phase, 60 Cycle, Overload Protection.

#### DISCONNECT DATA

Mfr.: Trumbull.  
Type A, 3 Pole, 575 Volt/40 H.P.—230 Volt/20 H.P.

three banks of 120/208-volts transformers, there were three master plans and 31 detailed, single-line diagrams.

By addition of horsepower or kilowatt ratings of machines, kilowatt demands and power factor data, these diagrams can be used for quick load reference purposes. Circuit conduit and conductor sizes can also be noted.

Circuit designation symbols were assigned in orderly and meaningful sequence and labels bearing same were attached to conduits and panels. Sample circuit identification is the symbol: 1a9D5-3. Each character has a specific meaning, as follows:

First character—a digit indicating transformer bank to which circuit is connected (Transformer Bank No. 1).

Second character—a lower case letter identifying main switchboard as-

sociated with transformer bank (Switchboard "a").

Third character—a numeral which is the number assigned to the feeder switch or circuit breaker on main switchboard (Switch No. 9).

Fourth character—a capital letter indicating the sub-panel (sub-panel D).

Fifth character—a numeral indicating number of switch on the sub-panel (Switch No. 5).

Beyond that point—hyphenated numbers are used to show further subdivisions in branch circuits (Branch circuit—3).

Normally, circuit designations are limited to five or six characters. The exceptions are at the far ends of branch circuits, such as circuit 2b6G7-8-3. At the main switchboard, designations have only three characters. In

each case, the circuit identification follows through from the transformer bank right down to the most remote branch circuit.

#### Equipment Index

Index numbers were assigned to electrical equipment in arbitrary sequence, starting with Motor No. 1, Controller No. 1, Disconnect No. 1, and so on. Labels with these index numbers are placed on motors and associated control equipment. These numbers can be assigned only once. If the equipment is subject to disposal, a record is made of such action but the number is never reassigned to any other unit. These numbers have been omitted from the single-line circuit diagrams to eliminate the need for re-

(Continued on page 140)



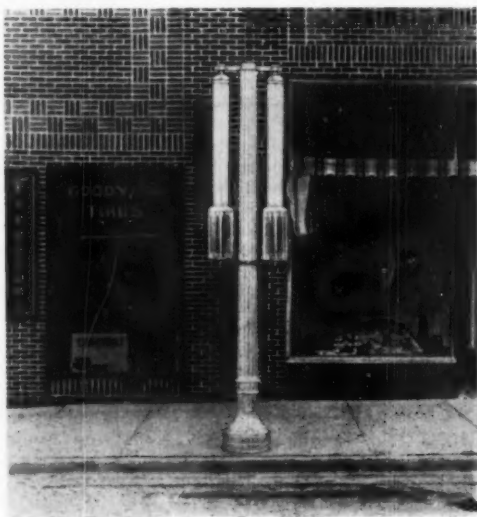
**BEFORE RELIGHTING,** Lakefield's business district looked like this at 10:30 P.M. No footcandle reading registered in middle of the 100-foot wide street and store fronts seemed gloomy to the prospective shoppers.

## RELIGHTING MAIN STREET

Fluorescent post lights mounted on existing standards bring the "white-way" to Lakefield's (Minn.) business district. System offers one solution to main-street lighting problems in many small cities.



**OLD INCANDESCENT** street lighting units had antiquated fixtures but sound posts.



**NEW FLUORESCENT** two-light cluster was mounted on each existing post after old lamp and globe was removed.



**AFTER RELIGHTING** with fluorescent post lights on existing standards, main street came to life. Footcandle intensity varied from 5.0 at buildings and sidewalk to 1.3 at center of street.

**B**RIGHTEST spot in Lakefield, Minn. (population 2,200) is the main business district. Since the street lighting was revamped, citizens from the small city and countryside are spending more time in town; are lingering longer in the stores instead of just shopping for necessities; are really enjoying their regular trips to town. Transformation of main street into a bright "white-way" is bringing more cash into the tills of local stores.

For a while, the city fathers and local business men were stymied. Relighting with high intensity units and installation of underground series circuits would have entailed a prohibitive bond issue. The solution was found in the use of fluorescent post lights installed on the existing standards and operating on the 110-volt circuits.

Within ten days after the Mayor saw a fluorescent post light, the 30 lighting standards (200-watt incandescent) illuminating the 100-ft. wide main street and sidewalk area were equipped with a two-unit cluster of post lights manufactured by the W. H. Long Co., Chicago. Each fluorescent unit contains four 40-watt, 4500-degree white, instant-start, lamps enclosed in round etched and ribbed glass panels. Each two-unit cluster is clamped securely to the existing standard after the top has been removed. Labor for the transformation was two hours per standard for a city electrician and helper. Cost of transforming 30 old standards was less than \$6,000.

Lighting data on this specific installation is as follows:



**BRIGHTLY LIGHTED** side walks and store fronts along Lakefield's relighted main street. Time: 10:30 P.M.

Lumen output per cluster (two post lights)—18,400	
Wattage per standard (8 40-watt lamps plus ballasts)—400-watts	
Distance between standards—80 feet	
Street width, building to building—100 feet	
Number of standards—30	
Number of post lights—60	
Distance from bottom of post light globe to ground—7.5 feet.	
Lighting Intensities in Footcandles	
Middle of street . . . . .	1.3
Traffic lanes . . . . .	1.5
Sidewalks . . . . .	5.0
Building fronts . . . . .	5.0
Midway between posts . . . . .	1.5

Lakefield now finds it easier to install decorative lighting. Decorations

can be attached to the top of the 2-inch pipe running the full length of each post light and electrical connections dropped down to a receptacle.

To aid city officials, business men and contractors in planning street lighting, the Long company conducts actual demonstrations. A Long truck rolls into town with a dozen post lights. At dusk the units are set up and plugged into nearby store outlets. After dark, the city fathers can see how their newly lighted street will appear. Spacing of the units can be varied until the desired lighting result is obtained. City officials need not journey to a distant town or city to view an installation, then return to transpose this mental impression to their own lighting problem.

**W**HEN fluorescent lamps are operated on alternating current (and most of them are), the mercury arc within the tube can set up radio waves which may cause a frying or cracking sound in radios. This interference is due to the rate of change of the electrical current in the discharge path as the current stops and starts 120 times a second on 60-cycle ac circuits.

Such interference can reach the radio in three ways:

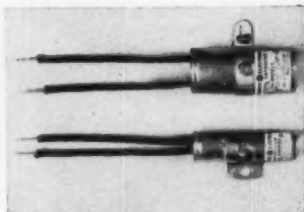
1. Direct radiation from the fluorescent lamp to the radio aerial circuit.
2. Direct radiation from the electric supply line to the aerial circuit.
3. Line feedback from the fixture through the power lines to the radio.

Regular broadcast frequencies are most affected (see curve). The amount of interference varies greatly among lamps of the same type and wattage, and the radio noise is generally not additive. This means that the total interference may correspond to the noise level of a single lamp.

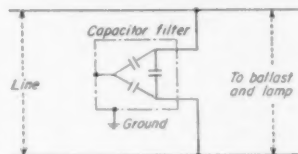
Not all fluorescent fixtures or installations cause radio interference. Approved starters and most instant-starting ballasts contain small condensers which reduce line radiation and feedback within the standard broadcast range in the ratio of 25-50 to 1. In many cases, these condensers incorporated with the auxiliary equipment will satisfactorily remove radio interference. Where trouble still exists, the following procedures will be helpful:

**Bulb Radiation** can be minimized by moving the radio and its aerial a short distance away from the lamp. If the radio cannot be moved away to this extent, keep the aerial proper out of the bulb-radiation range, use shielded or doublet-type aerial leads and provide a good ground.

Extended metal elements in the room may cause bulb radiation to travel greater distances. Grounded metal



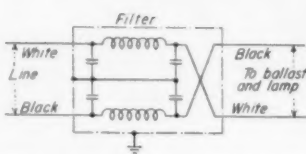
**CAPACITOR FILTERS** for permanent installations and portable equipment.



**CONNECTION DIAGRAM** for filter.



**INDUCTIVE-CAPACITIVE** filter. These filters greatly reduce line noise.



**CONNECTIONS** for capacitor filters.

## RADIO INTERFERENCE from Fluorescent Lamps

**Why fluorescent lamps cause radio interference and how to eliminate it.**

**By J. H. Campbell and C. L. Amick**

*Lamp Department, General Electric Co., Cleveland, Ohio*

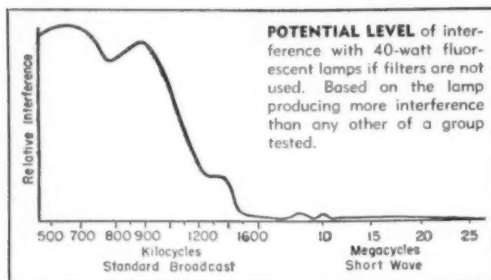
screens can be used to reduce bulb radiation where the set is necessarily close to the lamps, as on the work bench of radio service shops.

**Line Radiation** is caused by power lines to fixtures acting as miniature transmitting antennas. The field roughly corresponds to that of bulb radiation, and such interference may

be eliminated by protecting the radio in the manner just described or by filters at the fixture (see Line Feedback).

**Line Feedback** is interference transmitted through the power lines from the fixture back to the radio. The shorter the line between fixture and

(Continued on page 139)



### MINIMUM RECOMMENDED DISTANCE FROM LAMP TO RADIO TO AERIAL

Lamp Size	Distance
14-, 15- and 20-watt .....	4 feet
32-watt circline .....	5 feet
30-watt .....	6 feet
40-watt .....	8 feet
85- and 100-watt .....	10 feet
72- and 96-inch slimline .....	10 feet

LOOK FOR THE

# REDEGE



IT'S YOUR GUARANTEE OF  
**FINEST QUALITY**  
OUTLET and DEVICE  
**BOXES**

Experience—over 40 years of it—lies behind National Electric's **REDEGE** Boxes. Every detail has been carefully designed to assure an efficient, *quality* product.

**REDEGE** Boxes are made from the finest mild steel, full 14 gauge, assuring uniformity of

quality. The flush knockouts are cleanly cut with retainers that break at the knockout edge and leave no burrs. Nail and mounting holes are conveniently located for ease of mounting. **REDEGE** Boxes are *electro-galvanized* for *permanent* resistance to rust and corrosion.

Cable, conduit, concrete, device or gang boxes—whatever you need—the "**REDEGE**" signifies full compliance with Underwriters' Laboratories, Inc.

The "**REDEGE**" is  
the mark of quality.

EVERYTHING IN WIRING POINTS TO

**National Electric**  
**PRODUCTS CORPORATION**

1301 CHAMBER OF COMMERCE BUILDING, PITTSBURGH 19, PA.





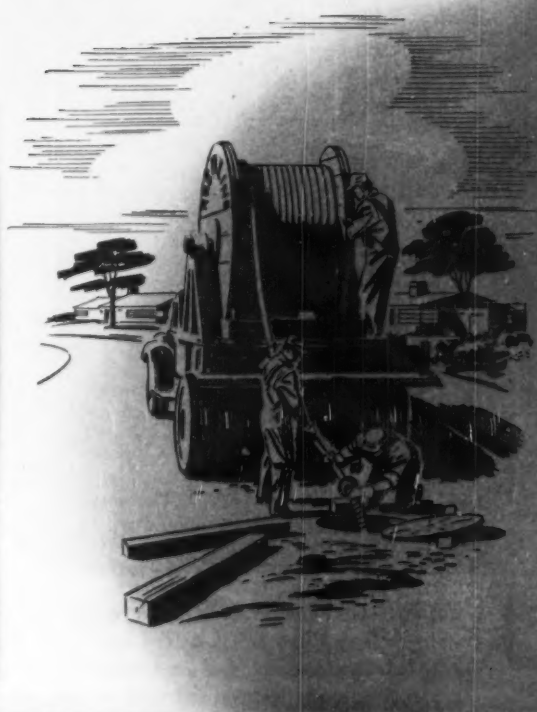
# Today it's Roebling!

## Unsurpassed service at lowest cost with Roebling Paper Insulated Cable

YOU NEVER WANTED ECONOMY MORE than you do today . . . and you'll get it by putting circuits underground with Roebling Paper Insulated Lead Encased Cables! No more unsightly overhead lines with their expensive upkeep . . . trouble-free service, uninterrupted and dependable, is yours for years on end.

Roebling Shielded Type H is outstanding for 3-phase grounded neutral circuits from 13 to 33kv. It is available in single and multiple conductor construction, in regular and Compack strand (round or sector). Conductors are shielded with metallized paper, individually insulated, protected with perforated copper shielding tape, and the whole assembly served with a bronze binder tape and lead sheathed. Similar assemblies can be made to your special specifications.

Your nearest Roebling office and sales engineer will be glad to help you select the *right* cable for top performance and economy. John A. Roebling's Sons Company, Trenton 2, New Jersey.



There's a Roebling electrical wire or cable for practically every transmission, distribution and service requirement. All of them are made completely in Roebling plants where the most modern techniques and precision machines assure products of the very highest quality.

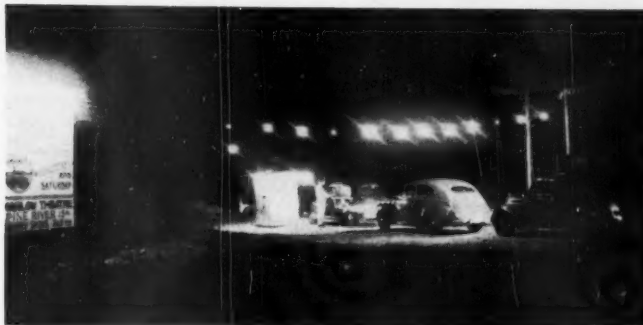
## ROEBLING

A CENTURY OF CONFIDENCE

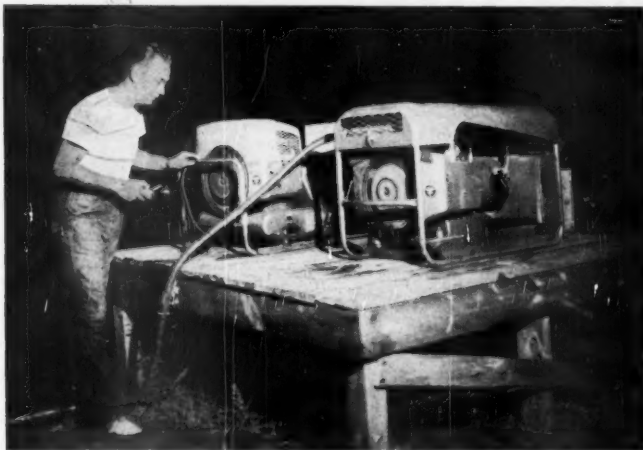
Atlanta, 934 Avon Ave. • Boston, 51 Sleeper St. • Chicago, 3225 W. Roosevelt Road • Cincinnati, 3253 Fredonia Ave. • Cleveland, 701 St. Clair Ave., N. E. • Denver, 4801 Jackson St. • Houston, 6216 Navigation Blvd. • Los Angeles, 216 S. Alameda St. • New York, 19 Rector St. • Philadelphia, 12 S. Twelfth St. • Portland, 1032 N. W. 14th Ave. • San Francisco, 1740 Seventeenth St. • Seattle, 900 First Avenue S.



# Practical Methods



**MOBILE POWER PLANTS** furnish electric energy to Marlow Mobil-In Theatres in remote vacationland areas of northern Minnesota.



**TWO 3-KW.** generating units, Onan Type 3CK, provide power for outdoor "Theatre on Wheels".

## Mobile Power For Resort Movies

John Rohr, owner of the Marlow Theatre at Pine River, Minnesota, has set up what is probably the first outdoor theatre chain in existence using mobile power and equipment. Consisting of three outdoor theatres, it is known as the Marlow Mobil-in Circuit. Each theatre is located in the midst of the densest resort areas of The Long Pine Playground Area of northern Minnesota.

The Marlow Mobil-ins differ from conventional "drive-ins" in several respects. The major distinguishing feature is that all the operating equip-

ment—projectors, sound system and even the power supply is mobile, permitting it to be used at each of the three drive-in locations on different nights. Two different shows per week are run at each location, with the entire circuit taking six days, Monday through Saturday.

In designing this "Theatre on Wheels" setup, it was realized the most important element is a dependable, inexpensive electric power supply. Also, any independent power supply would have to be extremely mobile and trouble-free, easy to handle, and air-

cooled to eliminate the water cooling problem.

All equipment in the Mobil-in setup pulls a total electrical load of about 10,000 watts: two projectors and high intensity lamps (4000 watts), popcorn machine (3000 watts), sound system and all miscellaneous signs, entrance, parking and trailer lights (3000 watts). But by ingenious figuring and staggering of loads, and providing a time schedule for operating the individual loads, it was possible to reduce power supply requirements to six kilowatts.

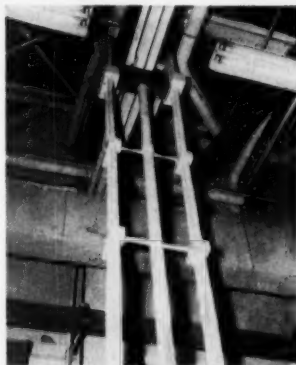
Two Onan 3CK 3000-watt power units were selected to supply power, instead of one large one which could handle the entire load demand. The two 3-kw. units are easy to handle, and can be loaded and unloaded with ease, leaving the truck on which they are transported free for the loudspeaker and other odd trucking jobs.

## Co-Axial Cable Support

WIRING

Co-axial induction heater cables and multiple control cables are supported in a simple and effective manner at the new diesel engine plant of the Caterpillar Tractor Co. in Peoria, Illinois.

The riser assembly shown in the accompanying photograph consists of four co-axial cables (two-conductor,



**SPLIT-BLOCK SUPPORTS** for co-axial cable risers are rigidly mounted by flat-iron brackets welded to center control cable conduit. Steel channel "troughs" bridge cables to induction heater locations.

## Longer Life On the Shelf!

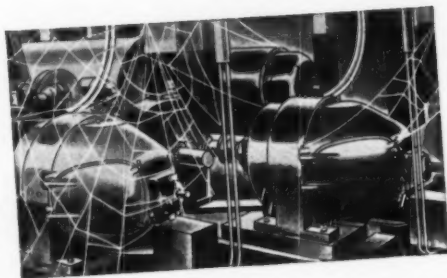
Irv-O-Flex tubing exhibits much greater shelf life! No longer need you worry over "first in, first out" inventory control! Use up Irv-O-Flex tubing to suit your own production scheduling!



# NEW! IRV-O-FLEX® TUBING Gives Longer Life!

## Longer Life On the Job!

The longer-lasting flexibility of Irv-O-Flex tubing enhances the durability of your products. Disassembly, servicing, and reassembly are greatly simplified with this new longer-life tubing!



At last you can get tubing that *stays flexible* on the shelf, *stays flexible* on the job! Outstanding improvements in resins and processing methods—results of Irvington's unceasing research—have culminated in Irv-O-Flex—a new insulating tubing of greatly extended flexibility. So superior, in fact, are its age-resisting characteristics that you can forget shelf-life worries, forget servicing difficulties, forget replacement troubles!

Irv-O-Flex tubing incorporates a tough, sturdy braid coated with an exclusive new Irvington synthetic resin. Both physical and electrical properties are outstanding. You'll want to test this versatile new tubing yourself—be sure to write for technical data, test reports, samples!

*Look to Irvington*  
for Insulation  
Leadership



**IRVINGTON VARNISH & INSULATOR COMPANY**  
Irvington 11, New Jersey

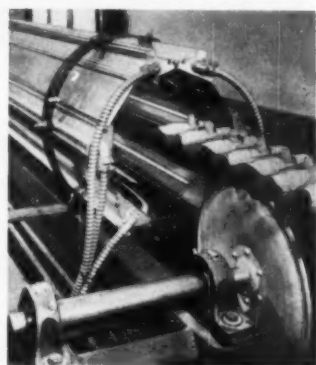
750 MCM, varnished-cambrie, lead-sheathed) and 38 No. 12, 600-volt, Type RU control conductors in a 3-inch conduit. Each pair of co-axial cables carries approximately 900 amperes of 9,600 cycle current at 860 volts from a 4-pole double throw switch to two induction heating units about 500 feet away in the machine shop area. The control conductors originate at a transfer switch, are split into two equal groups at the roof-truss junction box and then run to operator control cabinets at the induction heater locations. By means of the transfer switches, either hi-cycle generator can be used on either heater load—a system that eliminates long down-time on a production part should one of the generators fail.

The center control conduit provides the rigid support for the co-axial feeders. Flat-iron brackets, welded to the conduit, support hard maple split supporting blocks for the cables as does the roof-truss junction box. Steel channel-iron "troughs", with a shock-absorbing pad liner, carry the co-axial cables from the junction-box location to the actual load points. Conduits carry control wires from junction box to operator control cabinets.

## Drying Capacity Tripled With Infrared Oven

PRODUCTION

Accurate temperature control obtained through the use of infrared ovens prevents burning or under-baking of wash-dipped sand cores for the Milwaukee Flush Valve Company and

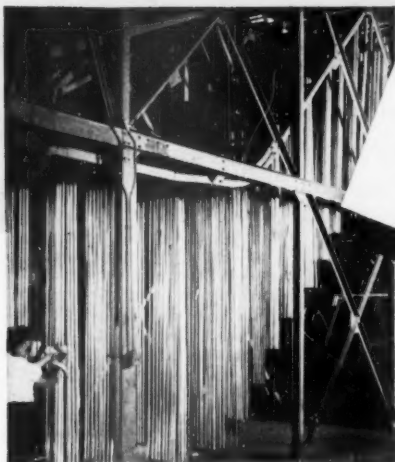


**DRYING OVEN** consists of six 3-kw Chromalox infrared heaters held in position by steel bands and stud bolts. Polished aluminum reflectors behind heaters intensify drying action. Cores move through oven on endless belt; require 2 minutes for drying.

*Because* **IT MUST BE RIGHT**



You can count on  
**TRIANGLE**  
HOT-DIP GALVANIZED  
**STEEL**  
**CONDUIT**



**Lasting Protection**—Smooth and uniformly hot-dip galvanized inside and outside, Triangle rigid steel conduit is dipped into special lacquer and baked in this endless conveyor equipment.

**Y**our own experience tells you that conduit fails where the galvanizing is thinnest. That's why Triangle's *uniformity* is important to you. For the severest service, where a single pin-point of penetration could open the way to rapid rust and early failure, users upon users repeatedly specify Triangle conduit. That's why you see more and more "Tristeel" flexible steel conduit, more and more Triangle E.M.T. and rigid steel conduit being used throughout refineries, on bridges over salt water, in increasing numbers of industrial plants. Users'

own impartial laboratory tests have repeatedly proved the superiority of Triangle—the conduit that's *uniformly* hot-dip galvanized...inside and outside...and then further protected by an exclusive new lacquer formulation!

Prove to yourself—in your own laboratory, or on your toughest jobs, that Triangle is the conduit you can count on!

The Trade Mark



Of Top Value

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**CONDUIT & CABLE CO., INC.**

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"GLAZON" BUILDING WIRE • BARE WIRE • ARMORED CABLE • GLAZON" NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE, SERVICE DROP, VARNISHED CAMBRIC BRAIDED OR LEADED, TRIOPRENE TRENCH, POWER AND PARKWAY CABLES • RIGID CONDUIT HOT-DIPPED GALVANIZED • ELECTRIC METALLIC THIN WALL CONDUIT • FLEXIBLE STEEL CONDUIT



"He says this one belonged to his grandfather — install it in the dining room!"

*P.S. That's a touching sentiment, Fatso, and traditions are fine, but that old device belongs in a museum. We have traditions here at P&S, too, that assure you dependable, easy-to-install wiring devices. Sixty years of know-how go into every P&S device. So when you want a dependable switch priced right for low cost homes . . . buy P&S!*



### look at this moderately priced T-rated switch

This precision-built, T-rated switch has torsionally pre-loaded contacts (patented) — a new design which means long life, smooth action, exceptional performance (especially with Type C lamp loads). Sturdy, all-enclosed all-bakelite bodies . . . positive kick-off . . . large head easy-to-wire binding screws . . . washer type, break-off plaster ears . . . meets or exceeds Federal and R.E.A. specifications, Underwriters' approved . . . rated 10 amps, 125 volts (T); 5 amps, 250 volts. Best of all, this switch is in the moderate price class — another high grade P&S wiring device that is easy to install.



P & S 7301

## PASS & SEYMOUR, Inc.

34 Boyd Ave. Syracuse 9, N. Y.

Maker of the famous P&S-Despard Line



**TEMPERATURE REGULATION** panel includes input controller which is set in accordance with heat values required for various types of cores. Heaters remain in operation only for baking cycles.

makes it possible to bake in 3 hours the quantity of cores formerly handled in a full day.

The oven, consisting of six all-metal Chromalox radiant heaters mounted at angles to form a circular drying tunnel, is temperature regulated by means of a variable input controller.

Breakage of cores is now minimized as cores are dry in approximately two minutes after dipping, while previous methods proved costly due to crumbling of soaked cores prior to drying. The input controller permits very close control and exact duplication of temperatures which are logged for various items passing through the oven. The entire oven may be turned off when not actually in use since it can be brought up to operating temperature again in two minutes. This feature alone has reduced operating costs \$400 annually.

## Panels

WIRING

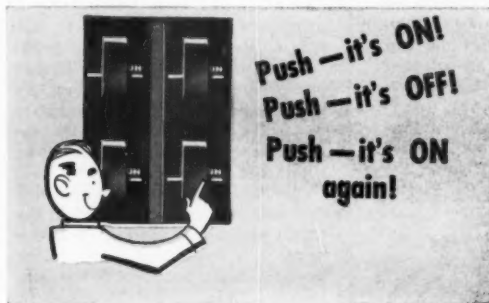
New compact circuit breaker panels make excellent "control centers" for residential appliance groups in keeping with modern "functional" concepts of residential work areas. By providing short individual circuits, they keep motor operated or intermittent control appliances off lighting circuits. Typical applications are, 1) the "kitchen control"; a 2 pole 50 amp. for the range, 4 single pole 20 amp. for refrigerator, dishwasher and 2 counter appliance circuits; 2) the "laundry control"; a 2 pole 30 amp. for the dryer, 4 single pole 20 amp. for the washer, ironer, and 2 outlets for the hand iron and hot plate.



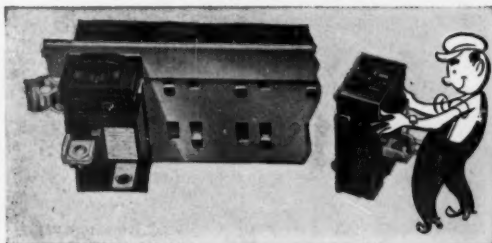
# "Here's why I'm changing to *Pushmatic*® Electri-Centers for every panelboard job"



**"Fastest delivery!** We used to lose out on rush panelboard jobs. Couldn't get equipment in time. But never again! Our local Distributor sold us on stocking a small, working supply of basic Electri-Centers and flexible, interchangeable Pushmatics. That way, we can give prompt delivery and installation. And our customers really appreciate fast service!



**"Simplest switching!** Nothing to it! A push of the finger switches the current either ON or OFF. If Pushmatic is automatically tripped by short or overload, just push and service is restored. No bothersome resetting by hand . . . no fuses to buy. Only Pushmatic offers simplest push-button switching.



**"Most flexibility!** Pushmatics are identical in size and contour, regardless of rating or type. That means each unit can be quickly inserted, removed or interchanged without disturbing other units. And Pushmatics are available in THERMAL-MAGNETIC or THERMAL MAGNETIC with exclusive AMBIENT COMPENSATING FEATURES to meet every load condition! They're rated at 15, 20, 30, 40 and 50 amperes, 1 pole, 120 V., or 2 poles, 120-240 V., AC.



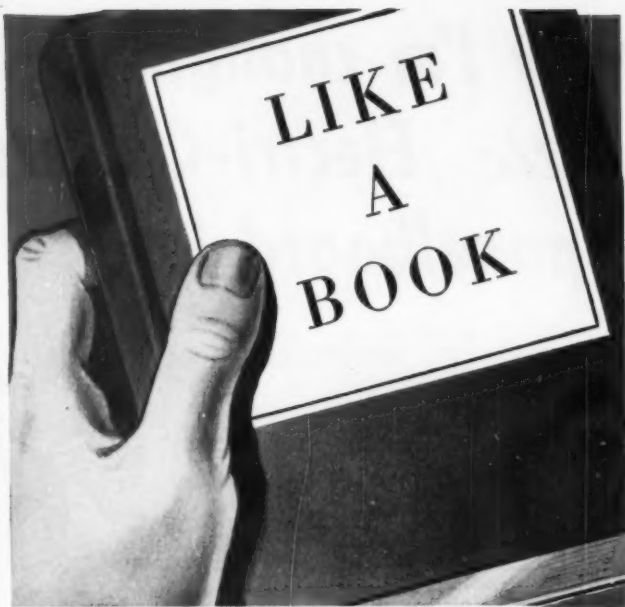
**"Surest protection!** Approved by Underwriters' Laboratories, quick-break Pushmatics operate with split-second precision when overload or short occurs. Automatic tripping is entirely independent of manual operation. And for installations subject to unusual temperature variables, new Ambient Compensated Pushmatics carry 100% of their normal rating at any ambient temperature between 30°F. and 150°F."

**BULLDOG ELECTRIC PRODUCTS COMPANY**  
DETROIT 32, MICHIGAN • FIELD OFFICES IN ALL PRINCIPAL CITIES  
IN CANADA: BULLDOG ELECTRIC PRODUCTS OF CANADA, LTD., TORONTO



## BULL DOG

PIONEERS IN FLEXIBLE ELECTRICAL DISTRIBUTION SYSTEMS



## IT'S WHAT'S INSIDE A JEFFERSON SAF-T-LAG FUSE THAT MAKES IT A BEST SELLER

Look inside a Jefferson THERMAL Saf-T-Lag Fuse and you'll quickly understand why the Saf-T-Lag is not just another non-renewable fuse but a triple duty fuse. It not only provides dependable protection on short-circuits and overloads but also protects against motor burn-outs due to single phasing of polyphase motors.

### It's a Thermal Fuse

Saf-T-Lags provide triple protection. (1) They afford prompt, adequate protection to wiring and equipment against **SHORT CIRCUITS**. (2) They furnish an extreme accuracy of calibration and a long **TIME-LAG** that eliminate unnecessary blows on harmless overloads of short duration. (3) Saf-T-Lags also provide **THERMAL** protection to panel boards and switching equipment thus avoiding damage caused by poor contact, insufficient air circulation or poor heat dissipation.

The use of copper for the link means low watt loss and a cooler operating fuse. The balanced design of the link guarantees equal heat dissipation with no hot spots.

Write for Folder 482-ST and learn why Jefferson Thermal Saf-T-Lags are not just another non-renewable fuse but a triple duty fuse.

*Approved by Underwriter's Laboratories.*

**JEFFERSON ELECTRIC COMPANY**  
Bellwood, Illinois

Send for Folder  
482-ST Today.



### The Jefferson Extensive Line of Fuses Includes:

Saf-T-Lag Thermal Fuses • Union Renewable Fuses • Super-Lag Renewable Fuses  
Union Indicating Fuses • Gem Non-Indicating Fuses • Plug Fuses and Postfuses

## IMPROVED WAY TO JACK CONDUITS [FROM PAGE 41]

runway and centered with the first trench, a second T-shaped trench is dug—also two feet from the runway.

This trench is about four feet deep and six feet long parallel with the runway. It is about 12 feet long at right angles to the runway. Section A-A through the T-shaped trench shows the 8-inch (or larger) channel iron about four feet long placed across the end of the 12-foot trench and resting on the bottom. The channel iron has a 3-inch diameter hole in the center and two  $\frac{1}{2}$ -inch rod loops welded at the top and bottom to hook on the blocks. (Note: these dimensions are for jacking 2-inch steel conduit, but larger conduits can also be jacked by this method).

A 30-inch length of 3-inch conduit, having a cap at the end and  $\frac{1}{2}$ -inch rod loops welded to it (Detail B), is placed over the end of the length of 2-inch conduit to be jacked. This first length is provided with a bull nose point at the front end. A 4:1 block and tackle using a  $\frac{1}{2}$ -inch steel cable is hooked to the loops and a truck (at least  $1\frac{1}{2}$  ton) is hooked to the cable end and drawn forward.

After each ten-foot length of conduit is pushed into the earth, the truck is also used to pull back the 30-inch length of 3-inch pipe to place it in position to receive the next section of conduit which is coupled to the preceding one. A two-inch by ten-inch wooden plank 10-ft long is used in the trench to form a working base.

On the Wichita Airport job which has a sandy, loam soil, an average of 100 feet of 2-inch pipe was pushed in in less than an hour, although most of the pushes were over 150 feet. By the conventional method, using a mechanical 20-ton hydraulic jack, it usually took about half a day to jack only 60 feet under similar soil conditions. Out of 1000 feet of conduit pushed on this Wichita project, by this new method, only one push had to be repulled. Some of the pushes projected on the other side of the runway within 2-ft of a stake aimed for.

Another advantage in this method is that only one man is required in the trench, and one in the truck. Furthermore, it is considerably safer to the working crew since there is less possibility of injury from the equipment used. It is estimated that on the Wichita job the cost of work accomplished by this method of jacking conduit was only half that it would have been had it been done by conventional methods.

YOU CAN BE **SURE**.. IF IT'S  
**Westinghouse**



## How Lee Lime Co. bagged a ***\$12,500 ANNUAL SAVING!***

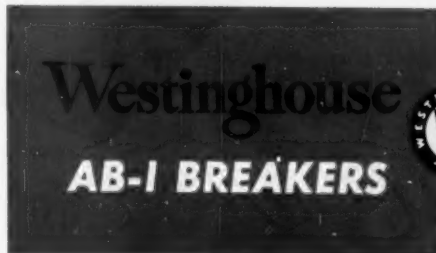
The Lee Lime Company of Lee, Massachusetts, faced a serious outage problem. Actual analysis showed each outage cost \$100.00 for lost production, labor cost and machinery breakage. 125 outages per year, due to ordinary fuse safety devices, added up to \$12,500. Looking for a way to eliminate this staggering loss, they installed two AB-I Breakers. Result? Complete elimination of 125 outages, and a \$12,500 saving was in the bag.

This dollar-saving experience led the Lee Lime Company to install other AB-I Breakers. The group pictured above eliminated one outage per day for an estimated annual saving of \$2,600.00.

Savings like these are worth getting. See for yourself the many superior features AB-I Breakers have over ordinary protec-

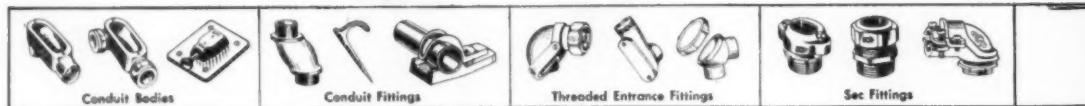
tive devices. AB-I Breakers permit harmless overloads, but trip instantly when a dangerous overload occurs. And remember, there are no fuses to replace, no delays in restoring service. The workman can restore service immediately without danger or exposure to live parts.

Get all the money-saving facts. Contact your nearby Westinghouse representative or write for Bulletin DB-30-230, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-30029



# Luxury tax?...

YES, SIR, you sure can pay a tax on fittings! Suppose the threading or some other feature of fittings is not just right. Your electrician loses time making an installation. Perhaps only a minute here, and a minute there. But minutes can run into hours, and hours into hundreds of dollars, in the course of a year. And all that extra cost is a tax you *have* to pay on the purchase price of "cheap" or inferior fittings.



# .... on Fittings?

WHEN YOU BUY GEDNEY FITTINGS you're never taxed for extra installation costs. Gedney Fittings are products of the most careful workmanship...machined with absolute accuracy...their threads fit...they're installed quickly, easily and with no lost time.

## MALLEABLE IRON— HOT DIP GALVANIZED

Most Gedney Fittings which are made of highest grade malleable iron are now given a special hot dip galvanized finish which is far superior to ordinary finishes. This thick zinc coating is supremely impervious to weather, condensation and corrosive attack...provides a fine appearance and assures thoroughly new measures of service life.

Conduit bodies and covers, fittings such as pipe straps and clamp backs...complete conduit systems...are now available with Gedney hot dip galvanizing.

## A COMPLETE LINE— WITH MANY SPECIAL FEATURES

Gedney brings you a complete line of electrical fittings...enables you to make installations with matching, quick-to-install Gedney products from start to finish.

And the special design features of many Gedney fittings bring substantial savings over and above those effected by accurate machining. You'll find in the Gedney line fittings that simplify a wide variety of installation jobs...fittings that permit shortcuts formerly impossible...that improve the characteristics of an installation...boost its efficiency...improve its appearance.

## ORDER GEDNEY FITTINGS FROM YOUR WHOLESALE

Gedney Fittings are sold only through wholesalers, and Gedney wholesalers are ready to meet your every fitting requirement. Place an order today and learn for yourself the *extra* quality, extra economy of Gedney Fittings.

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Armored Cable Fittings



Non-Metallic Cable Fittings



Ground Fittings



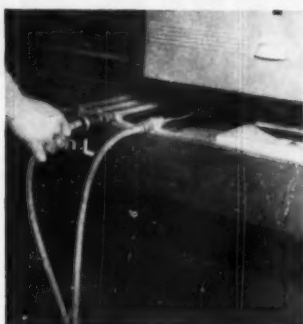
EMT Fittings



# Motor Shops



**PORTABLE OVEN** for heating soldering iron can be plugged into gas line beneath work bench; quickly disconnected and pushed aside when not in service.



**GAS LINE** is one of several services carried beneath working benches. Connections are push-pull pressure-valve units with no handles to turn or threads to engage.

## Service Outlets For Work Benches

The use of compressed air, gas, live steam, hydrogen or other similar services frequently involves considerable piping, a maze of connections or the use of steel tanks located at various points around a shop in order to provide these facilities to the several working areas. In the shop of the Braunlich-Roessle Company in Pittsburgh, however, these services are carried in series of pipes located beneath work benches, out of sight and out of the way, keeping floors and ceilings free and protecting the pipes against possible damage. Outlets beneath each working space are of the pressure valve type, with the outlets remaining sealed unless a nipped connection is inserted into the service pipe outlet. Whenever a repair electrician requires a particular service, he merely plugs in the flexible hose on the equipment he wishes to use and thereby establishes his utility contact. Since all connections are push-pull pressure-valve construction, there are no handles to turn, no threads to engage and no parts to wear out. And, when the equipment is not in service, it can be quickly disconnected and either used in another part of the shop or pushed aside, out of the way of men working at the benches.

One of several such devices is a gas-fired oven for heating soldering irons. Mounted on a rolling framework, with shelves beneath for carrying solder wire and paste, the oven can be pushed to the bench requiring it, the gas line can be plugged into

the gas pipe beneath the bench and the oven is ready for service. When the oven has served its purpose, it can be pushed aside, carrying with it all residual heat and keeping the working areas free for other operations.

## Oil-Heated Burnout Oven

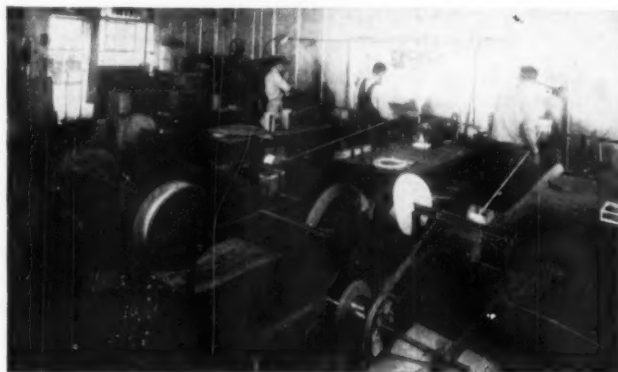
Flame does not touch the frames of motors whose windings are burnt out in the new rectangular, brick-lined, steel burnout oven designed and built

by Lansing Electric Motors motor repair division in Lansing, Michigan. While the oven is fired by a gun type oil burner, the flames are confined by a fire-brick retort and only the hot air reaches the windings. Net result: Charred windings but no warped frames; clean slots and frame that require only brushing.

The oven enclosure is 73 inches long, 61 inches wide and 48 inches deep; is constructed of angle-iron frame with sheet steel ( $\frac{1}{8}$ -inch thick) side panels; has a 4-inch lining of insulating brick and a counter-weighted sheet steel cover also lined with similar insulating brick; takes up to a 200 hp., 1200 rpm., stator. The oven floor is lined with fire-brick topped with sheet steel plate. A trough of sand around the oven top seals the cover when it is closed.

Two channel uprights at the back of the oven act as guides for the heavy, solid, round steel bar counter-weight attached by steel cables to the front corners of the heavy cover; also support the pulleys over which the counter-weight cables pass; and provide a rigid support for the heavy cover hinges.

Thermostatic controls automatically shut off the oil burner when the oven temperature reaches 1,000° F. Ignition of the winding insulation is controlled by the automatic stack damper. If the windings ignite and burn, the oven temperature will rise above the 1,000 degree limit and the stack damper automatically opens, drawing air out of the room instead of out of the oven. With no oxygen to support



**SECTION OF TRANSFORMER** winding department at Dowzer Electric Machinery Works, Inc., Mt. Vernon, Illinois. Shown are three of the nine winding lathes in the shop.

the Name is... **FAIRBANKS-MORSE**

*Here's "CUSTOMER APPEAL" for You!*



### *Here's the Axial Air-Gap Motor*

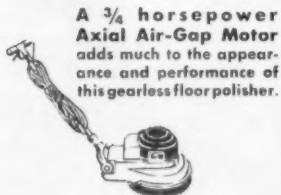
Motor users have been quick to add the advantages of the Axial Air-Gap Motor — the motor that is lighter than conventional types by 30% — shorter by over 40%. These advantages add up to a convincing amount of "customer appeal" to anyone interested in a more compact, streamlined and attractive driven machine. Too, Axial Air-Gap Motors offer additional appeals: they have a minimum number of parts, are easy to service and lend themselves to simple mounting — horizontally, vertically or right angle pivot base. Available as polyphase squirrel cage and capacitor start single phase motors — up to ten horsepower — they deserve first consideration for a wide range of applications.



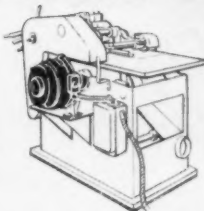
#### **Send for Axial Air-Gap Motor bulletin!**

Bulletin 2760 gives the whole story on Axial Air-Gap Motor design, application and construction. Write or call your nearest Fairbanks-Morse branch office (listed on these pages) for your copy.

#### **Where Space, Weight and Appearance Count**

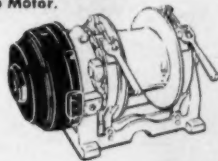


A  $\frac{3}{4}$  horsepower Axial Air-Gap Motor adds much to the appearance and performance of this gearless floor polisher.



Reduced overhang, thanks to the Axial Air-Gap Motor, is a decided asset on this modern saw.

This drum hoist is lighter, more compact through the use of the Axial Air-Gap Motor.



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General purpose protected frame motors



Totally enclosed fan-cooled motors



Totally enclosed non-ventilated motors

### Here are the motors with indestructible copper-spun rotors!

Here is an exclusive feature of Fairbanks-Morse polyphase squirrel-cage motors—a one-piece, centrifugally cast copper winding that, to a greater extent than other types, is dense, ductile, strong—with higher conductivity and lower thermal expansion. This is heavy duty design that can stand severe service and high temperatures. It enables Fairbanks-Morse Motors to operate efficiently under adverse conditions—types of service where ordinary motors deteriorate rapidly. It's a design that anyone ought to know more about before buying any motor, for it assures more successful low-cost operation.

### "Pocket Panorama" shows the whole "line-up"



Here in a handy pocket pamphlet are illustrated over 40 types and sizes of Fairbanks-Morse motors and generators. Write or call your Fairbanks-Morse branch office to get your copy.



Explosion-proof motors

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# FAIRBANKS-MORSE

## *Here's Built-in Longtime Motor Satisfaction*



Cross-flow ventilation is another exclusive Fairbanks-Morse advantage.\* It means uniform, symmetrical cooling that eliminates hot spots and prolongs the life of the insulation. Openings are arranged so that there are no exposed moving parts to catch clothing or fingers—a safety factor of prime importance in many installations.

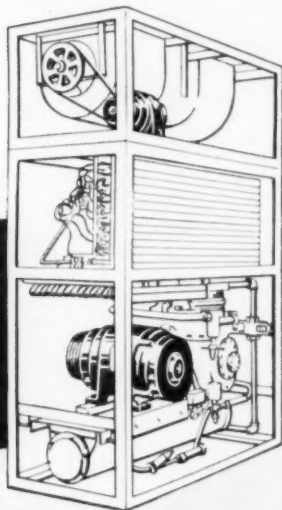
There are many other important features that have made Fairbanks-Morse a name respected wherever motors are used. Ask your Fairbanks-Morse motor specialist about them and you'll find out why, for the broadest range of your motor services, it's best to consider Fairbanks-Morse first.

\*NEMA frames 224 to 365 inclusive

### **For EXAMPLE —**

This popular self-contained, water-cooled air conditioning unit has a ten-horsepower motor driving the compressor and a one-horsepower motor on the fan. "We have been using Fairbanks-Morse motors for ten years," says the company president, "and we have found them highly satisfactory—silent in operation—and they demand little servicing."

This company uses Fairbanks-Morse Motors from  $\frac{1}{2}$  horsepower all the way up to 50 horsepower and is one of hundreds of companies standardizing on Fairbanks-Morse, for long-time motor satisfaction.



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*Nothing Else Like It!*

### **THE MOTORGear**

*Industry's most compact slow speed unit*

Here's a sure, easy way to simplify your slow speed drives. The unique Motorgear combines the modern, dependable Axial Air-Gap Motor with a simple, sturdy helical gear train. The compactness and ease of mounting of the Motorgear make it more easily adaptable to a wider variety of applications. Wherever it is used, the Motorgear improves the appearance as well as the performance of the driven machine. For details write or call your Fairbanks-Morse branch office for your copy of the Motorgear bulletin.



**FAIRBANKS-MORSE.**

*a name worth remembering*

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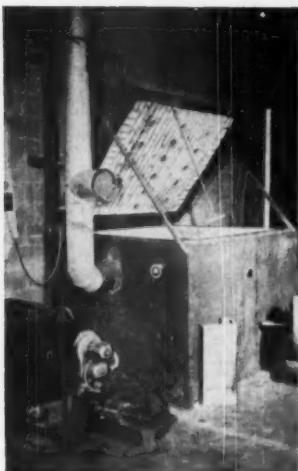
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**OIL-HEATED BURNOUT** oven in truck-loading enclosure at Lansing Electric Motors. Stack damper, thermostat and oil burner shown in foreground; inspection tube in oven side at right.



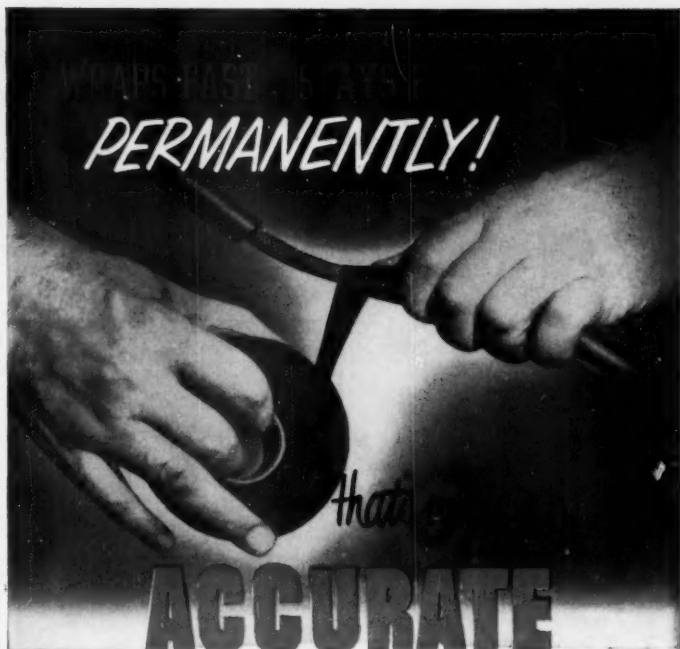
**INTERIOR OF OVEN** showing stator windings charred by hot air. Fire-brick retort is over burner nozzle at left.

combustion, the flames will go out and the windings will continue to char. Visual detection of burning windings is possible by looking through a glass covered opening in the side of the oven. There is an oven draft control near bottom of enclosure, but it never has been necessary to use it.

Normally, about 20 minutes are required to bring the oven temperature up to the 900 or 1,000 degrees, depending upon the number of motors in the oven at the time. Records indicate an interval of 40 minutes before the gas was automatically shut off when the oven contained 17 motors. As yet, oven operation has never extended a full hour.

The oil burner consumes about two gallons of fuel oil per hour—averaging a 28-cent per hour operating cost based on 14-cent oil.

With automatic control and with facilities for mechanical load handling, baking is completed easily.



## FRICITION AND RUBBER TAPES

*assure* **BETTER INSTALLATIONS  
BETTER WIRING JOBS**



**ACCURATE FRICTION TAPE** — Saves time on toughest jobs! It never ravel, tears off clean always, has extra strength for tight, fast wrapping. Clean to work with, Accurate Tape sticks permanently to the work—never to your fingers. For safe, sure protection from abrasion, scuffing and pinching, there's no substitute for Accurate Friction Tape.



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## Hydraulic Lift Cuts Motor Handling Time

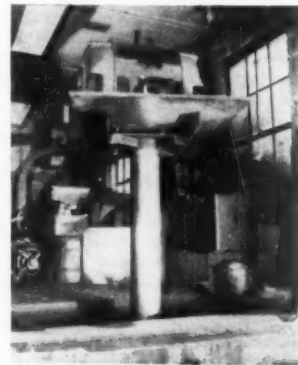
Like most motor repair establishments, Wayne Electric Company, Ft. Wayne, Indiana, has all types and sizes of motors come into the shop for repairs; and all types and sizes of trucks may make the delivery or pick-up. To further complicate the equipment handling problem was the fact that the structural features of the building precluded the use of heavy overhead crane or monorail systems.

To handle heavy motors, Wayne mechanics supplemented available hoisting equipment with plenty of muscle power until partners John Kayser and Elmer Furhman discovered and acquired an unused service station type hydraulic lift. Now loading and unloading heavy units is a snap.

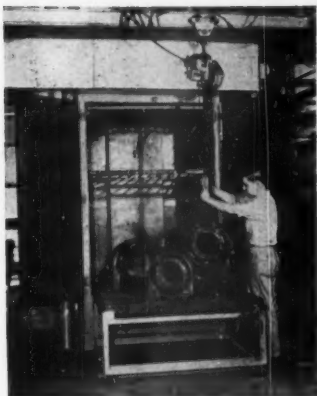
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**UNDERSIDE OF LIFT** showing method used to mount the  $\frac{3}{4}$ -inch solid steel platform. Lift has a maximum rise of 54 inches.



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# Industrial Electrification

## Ballasting Fluorescent Lamps

A discussion of the reasons for, and various ways of, ballasting fluorescent lamps.

By H. C. JONES

Specialty Transformer Specialist  
General Electric Company  
Philadelphia, Pa.

**L**IGHT from a fluorescent lamp originates from an electric arc between two electrodes enclosed in a tubular glass bulb. This bulb is filled with mercury vapor and a rare gas. The inside of the bulb is coated with a phosphor. The phosphor fluoresces, or emits visible light, when excited by the invisible ultra-violet energy generated in the mercury vapor arc.

The fluorescent lamp, unlike the conventional hot filament incandescent lamp, is an "electric discharge" light source. Where the incandescent lamp, being a positive resistance, follows Ohm's law of "voltage equals current times resistance", a fluorescent lamp does just the opposite. This is because after breakdown is achieved, an electric arc has a "negative resistance" characteristic. That is, as the current through the lamp goes up, the voltage across the fluorescent lamp goes down.

It is obvious, if no means were employed to control the current resulting from this "negative resistance" characteristic, this current would rapidly reach such proportions as to destroy the lamp. This is where the ballast comes into the picture.

Electric arcs can be ballasted by three types of current limiting devices; resistors, capacitors and inductive reactors. An analysis of voltage and current relationship in each case is shown in Fig. 1.

Fig. 1-A shows one cycle of the current and voltage with a resistance ballast. The vector diagram shows the line voltage, voltage across the ballast, lamp voltage, and line and lamp current all in phase with one another. The voltage increases until it reaches a value which is sufficient to ionize the rare gas in the fluorescent tube. This value of voltage is known as the "ionizing potential." The mercury is vaporized in the resulting arc and current flows during the time from A to B in the first half of the cycle and again between A' and B' in the second half of the cycle. The current flows from the time of ionization, point C, until the voltage reaches a value,

point D, at which it will no longer maintain the arc. At the deionizing point D, the arc is extinguished and the lamp current stops until the voltage again reaches the ionizing point C', in the second half of the cycle. Then the same sequence is repeated in the second half of the cycle. The fluorescent lamp is only lighted while cur-

rent is flowing, that is, for the times from A to B and A' to B'. It can be seen, therefore, that the lamp is only lighted for a fraction of each cycle, which results in a low light output. The resulting flicker is another objection to operating a fluorescent lamp with a resistance ballast. A third objection is the large wattage loss in the ballast. Since the current through the ballast,  $I$ , and the voltage across the ballast,  $e_R$ , are in phase, the wattage loss is equal to the lamp or line current squared times  $R$ . This loss

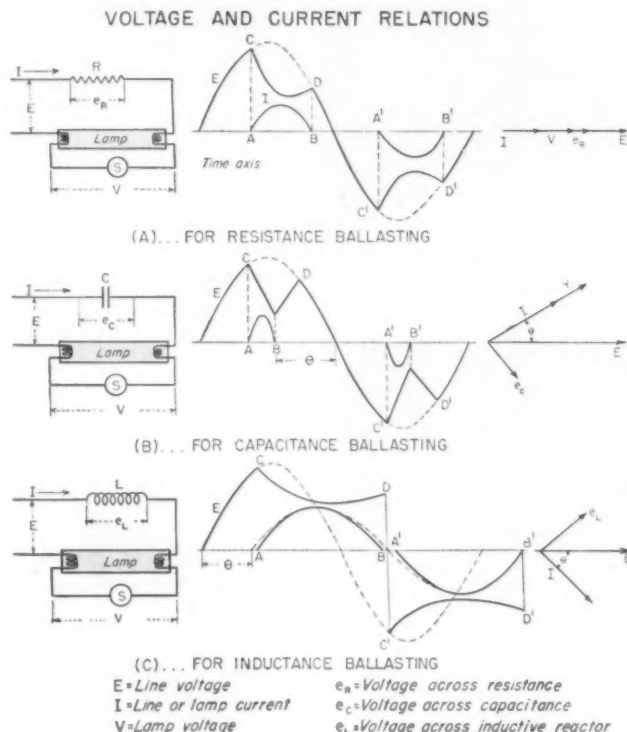


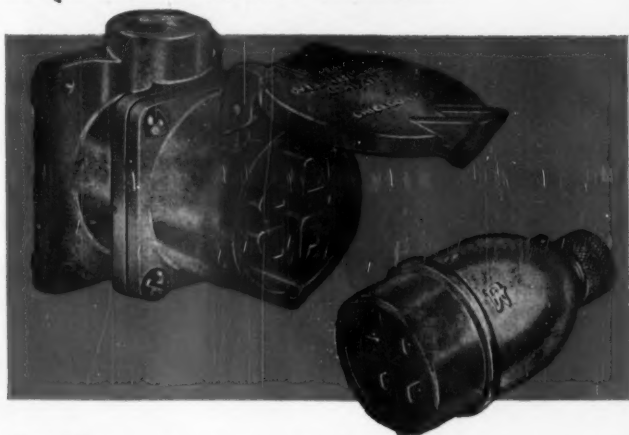
FIG. 1—Three types of current limiting devices used for ballasting electric arcs are: (A) resistors; (B) capacitors; and (C) inductive reactors.

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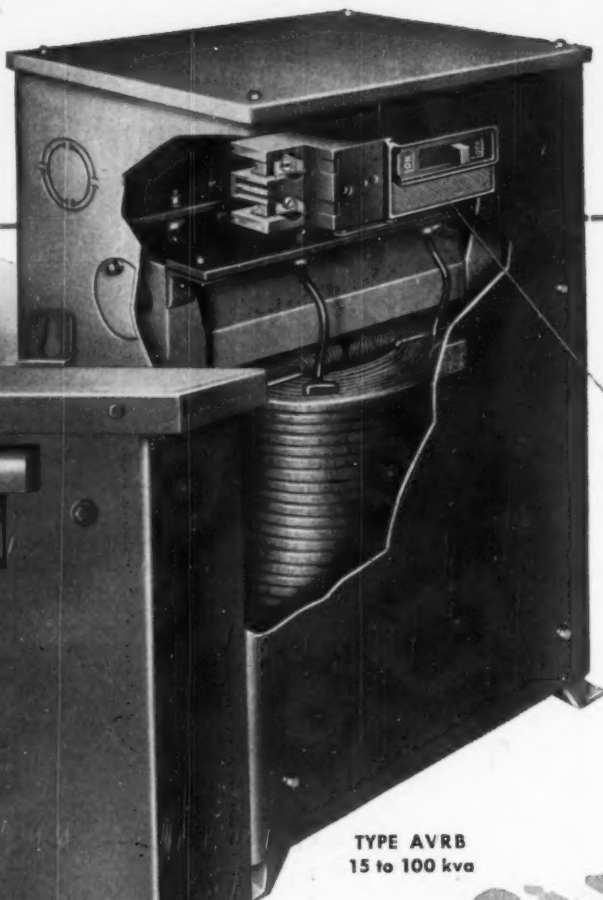


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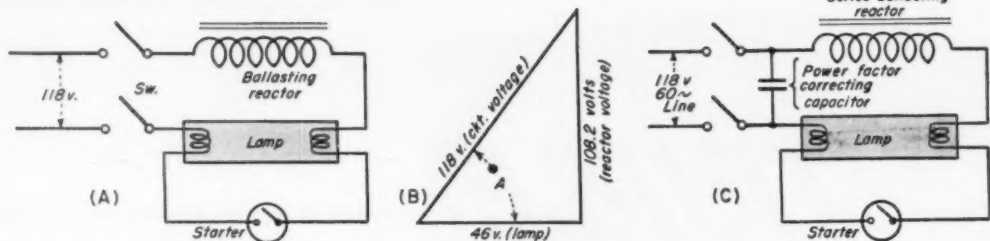


FIG. 2—Reactor ballast circuit (A), and vector diagram (B) used for determining voltage across reactor for a 15-watt T-12 fluorescent lamp. Capacitor installed across line (C) improves power factor.

is much greater than the loss in an inductive ballast, as will be seen in the analysis of an inductive ballast given below. The current and voltage in an inductive ballast are out of phase, and the current component in phase with the resistance of the ballast is relatively small.

Fig. 1-B, giving one cycle of the current and voltage with a capacitance ballast, shows roughly the same relation that was shown in Fig. 1-A. In this case, however, the capacitance has no resistance to speak of and so the losses in the ballast are negligible. The fact that the lamp is only lighted for a fraction of the cycle results in an objectionable flicker and low light output. In the case of the capacitance ballast, however, these objectionable features can be eliminated if the line voltage is appreciably increased. The value of ionizing potential is a constant, and it can be seen that if the amplitude of the voltage  $E$  were raised, the distance between A and B and A' and B' would increase. An increase in voltage then, will allow the lamp to stay lighted a greater portion of the cycle time. The high voltage, of course, brings on other problems; namely, it necessitates a capacitance with high voltage bushings, and also introduces a safety hazard. The operation of fluorescent lamps with capacitance ballasts is not satisfactory at voltages less than about 2300 volts.

The voltage and current relations of an inductance ballast are shown in Fig. 1-C. It can be seen that the time of current flow in this case extends over practically the entire cycle. In the inductance ballast, there is a wattage loss equal to current squared times ballast resistance. However, as shown in the vector diagram, the current is out of phase with the voltage, and this loss is not as great as the loss in the straight resistance ballast. From economy and performance standpoints then, inductive reactors used as ballasts, at conventional voltages, are by far the most practical of the three types.

Briefly, the problem in designing an inductive reactance ballast is to deter-

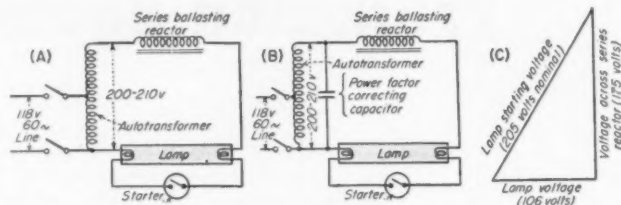


FIG. 3—Ballasts for single 40-watt, 48-inch T-12 fluorescent lamp. Low power factor ballast consists of autotransformer and series reactor (A). High power factor ballast also contains capacitor (B). Vector diagram (C) is used to determine voltage for series reactor.

mine the rating of a reactor which is capable of limiting the current in a given size fluorescent lamp to rated value. In general, a reactor is rated according to voltage, current and frequency. Inasmuch as the line frequency will be known, as well as the lamp current and voltage, it remains to determine the voltage across the required ballast reactor.

For an example of ballast design procedure, used to indicate the function and use of ballasts, the 15 watt T-12 lamp, which is in wide use today in small home and office fixtures will be considered. The approximate lamp current for this lamp is .33 amperes as shown in Table I. The approximate lamp volts are 46, and the circuit volts range from 110 to 125.

Assume that this lamp is to be operated on a 60 cycle, 118 volt (average of 110 and 125 volts) circuit. A simple diagram of this circuit is shown in Fig. 2-A.

First step in determining the unknown reactor voltage rating (voltage across reactor) is to draw a vector diagram (Fig. 2-B).

Assume that the 15 watt T-12 fluorescent lamp has a unity power factor. As an inductance causes a lagging current, the resulting overall power factor of the ballast reactor and lamp combined will be  $\cosine A$ . It is known that the side adjacent to angle A is the voltage across the lamp, or 46 volts. Knowing the hypotenuse and one side of a right triangle, the third

side can be solved by the Pythagorean theorem. It is thus determined that the quadrature component of the circuit voltage is 108.2 volts, which is the voltage across the ballast reactor.

For starting a fluorescent lamp, an initial starting current is required to heat the electrodes. The starter switch between the two electrodes of the lamp is shown in Fig. 2-A. This starter is often a bimetallic switch enclosed in a glass envelope filled with a rare gas. The starter switch is normally open. When line switch "SW" is closed, full line voltage (118 volts) is impressed across the starter switch, causing ionization of the rare gas. The heat generated by this ionization causes the bimetallic switch to close momentarily. While the switch is closed, an electrode pre-heat starting current flows. As soon as the switch closes, ionization of the rare gas ceases, and in a very short time the bimetallic contact strip cools. On cooling, the switch opens again. The starting current, when flowing through the ballast, sets up a magnetic field. When the starter switch opens, and the current flow stops, this magnetic field collapses, causing an "inductive kick." This causes a high voltage to appear between the electrodes at either end of the lamp, which strikes the initial arc and lights the lamp. Incidentally, this "kick," a characteristic peculiar to an inductance, is another advantage to the use of an inductive reactance as a ballast. After the lamp has been lighted, the voltage

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across the starter switch is equal to the voltage across the lamp. It is not of a magnitude great enough to maintain ionization of the gas in the starter, so the starter contacts remain open. Some small wattage lighting units, such as desk lamps, do not have starters, but instead have manual push-button switches which perform the same function.

In the case of a 15-watt, T-12 lamp, the previously mentioned momentary starting current may be from 50 percent to almost 100 percent greater than the rated running current of the lamp. This means that the wire in the ballast reactor, which is considered here must be capable of carrying .65 amperes. The question arises, if the starting current is only of short duration, why should the ballast have to be designed to carry this large current continuously? A starter, like any device with a movable element is subject to failure. If it were to stick in the closed position, the lamp would never start, but the ballast would be carrying full starting current continuously. If it were wound with wire only capable of carrying .33 amperes, the ballast would overheat in a short time.

To summarize, it has been determined that for ballasting a 15 watt lamp when operating on a supply of 118 volts 60 cycles, a reactor is needed which will pass .33 amperes when 108.2 volts, 60 cycles, are applied to it, and a reactor which will be wound with wire capable of passing .65 amperes.

The calculations above are for a low power factor ballast for a 15 watt fluorescent lamp. A high power factor ballast of this same rating will now be considered.

A reactor in an a-c circuit gives a lagging power factor; that is, it makes the current lag the voltage. Power factor as near unity as possible is preferred. Some power companies require, under penalty to the customer, that the power factor be at least 85 percent. To correct the lagging power factor resulting from the introduction of an inductive reactor into the circuit, capacitive reactance must be added. A capacitor has just the opposite effect of a reactor, and causes the current to lead the voltage. The problem is now to determine the value of a capacitor which will compensate for the lagging current and bring the power factor to near unity. This capacitor will be connected across the line as shown in Fig. 2-C.

The volt-ampere rating (VA) of this capacitor can be determined by multiplying the quadrature component of the voltage in Fig. 2-B, which is 108.2 volts, by the rated lamp current, .33 amperes. Then the value of capacitance, in microfarads, is determined by sub-

stitution in the formula below, and found to be 6.8 microfarads:

$$C = \frac{10^6}{6.28 f E_4} \quad E = \text{line voltage}$$

$$C = \frac{10^6 \times 108.2 \times .33}{6.28 \times 60 \times (118)_2} \quad f = \text{frequency}$$

$$C = 6.8 \text{ microfarads} \quad C = \text{capacitance in microfarads}$$

The current through this capacitor will be the VA of the capacitor divided by the line voltage or, .33 amperes. Power factor correction can be checked by first adding vectorially the capacitor and reactor currents to get the total line current. Then the line power factor will be the in-phase component of this total line current divided by the total line current.

The voltages required to start and operate a fluorescent lamp are functions of the length and diameter of the particular lamp. Higher ratios of length to diameter require higher starting voltages. The shorter lamps generally require lower voltages than the longer, larger lamps. The 6, 8, 14, 15, 20 and 25 watt lamps, when properly ballasted with series ballasting reactors, operate satisfactorily on conventional voltages of from 110 to 125 volts. The 30, 40, 85-100 watt, as well as the 32-watt circline and slimline lamps require larger voltages because of their physical dimensions.

A ballast for one of the larger lamps is now considered, the 48 inch T-12 40-watt lamp. As shown in Table I, the operating current for this 40 watt lamp is .42 amperes and the voltage required across the lamp during operation is 106 volts. Taking into consideration the voltage drop across the necessary series ballasting reactor, it is seen that the 110 to 125 volts of the supply circuit will not be sufficient. The supply voltage must be boosted to about 200 to 210 volts by a step-up autotransformer, which is incorporated in the ballast. The ballast will then consist of an autotransformer and series reactor, as shown in Fig. 3-A.

If the ballast is to be of high power factor design, it will have a parallel capacitor as an additional component, shown in Fig. 3-B. The electrical factor design, which will have a parallel capacitor, are again calculated in the same manner that the corresponding values for the 15 watt ballast were determined.

For calculation purposes, a right triangle (Fig. 3-C), should be constructed. This is similar to Fig. 2-B for the 15 watt ballast except this time the hypotenuse is the lamp starting voltage or the output voltage of the autotransformer. It should be between 200 and 210 volts. This value is assumed to be 205 volts, for calculation purposes. Solving for the unknown side



TABLE I—OPERATING CHARACTERISTICS  
FOR SWITCH-START TYPE FLUORESCENT LAMPS

Normal Lamp Wattage (Watts)	Lamp Diameter (Inches)	Normal Lamp Length* (Inches)	Lamp Current (Amperes)	Lamp Voltage (Volts)	Starting Voltage (Volts)	Starting Current Range (Amperes)
4	5/8	6	.120	38	118	.....
6	5/8	9	.145	48	118	.....
8	5/8	12	.180	54	118	.....
13	5/8	21	.16-18	90-100	200	.18-.27
14	1-1/2	15	.375	41	118	.44-.65
15	1	18	.310	55	118	.44-.65
15	1-1/2	18	.330	46	118	.44-.65
20	1-1/2	24	.360	59	118	.44-.65
25	1-1/2	33	.52	33	118	.44-.65
30	1	36	.355	98	200	.46-.65
40	1-1/2	48	.420	106	200	.55-.75
85	2-1/8	60	1.60	57	150	1.35-2.20
100	2-1/8	60	1.50	71	150	1.35-2.20
32 (circline)	1-1/4	12 Diam.	.43	84	150 Max.	.....

(\* Includes lamp and two standard lamp holders).

of this triangle shows the voltage across the reactor to be 175 volts. Referring to Table I it is seen that the reactor must be capable of carrying a starting current of .75 amperes maximum.

The reactor, then, must pass .42 amperes when 175 volts, 60 cycles, are applied, and must be wound with wire capable of carrying .75 amperes continuously.

In some cases it has been found economical to design the autotransformer with a high leakage reactance for ballasting effect. This can be done by spacing the common winding away from the extended winding and using a magnetic shunt to reduce the flux linkage between the two windings. This reactance in the autotransformer materially reduces the required size of the series-reactor. This is, however, a manufacturing detail which needs no further treatment.

Consideration will now be given to ballasts for the operation of more than one lamp. It can be readily seen that economies can usually be realized by constructing a multiple lamp ballast, since the cost per lamp ballasted will usually be lower than the cost of a separate ballast for each lamp. This is especially true in the case of high power factor two-lamp ballasts.

Since fluorescent lamps are arc discharge light sources, and arcs cannot be operated in parallel, it is necessary to have a series ballasting reactor for each lamp.

A low power factor 20-watt or smaller, two- or three-lamp ballast simply consists of separate reactors for each lamp, contained in a single case, (Figs. 4-A and 4-B).

Two-lamp and three-lamp high power factor ballasts are a little more complicated. Fig. 5-A shows a two-lamp wiring diagram. The two-lamp design

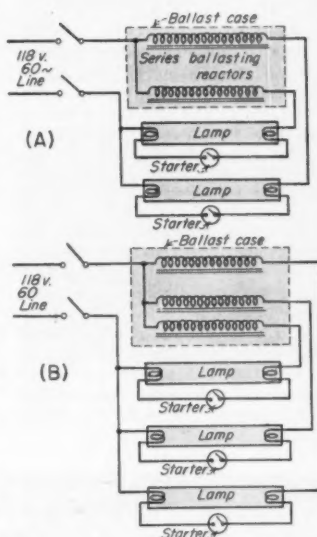


FIG. 4—Low power factor ballasts for two or more 20-watt (or smaller) fluorescent lamps have a separate reactor for each lamp. (A)—two 20-watt lamps; (B)—three 20-watt lamps.

consists of two circuits, a lead and a lag, with a common autotransformer. These circuits are so named because in one the current leads the voltage and in the other it lags the voltage. The effect is, in principle, a "split-phase." The lag circuit reactor, which is, in the case of a 40 watt lamp, of the same value as the reactor in Fig. 3-A, has a lagging power factor of about 60 percent. The lead circuit, which consists of a reactor and a capacitor, is predominately capacitive and has a leading power factor of about 60 percent. The result is an overall power factor which approaches

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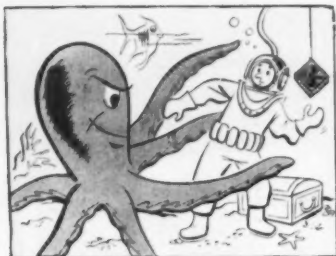


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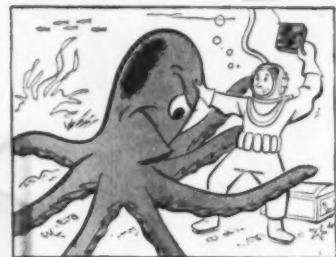
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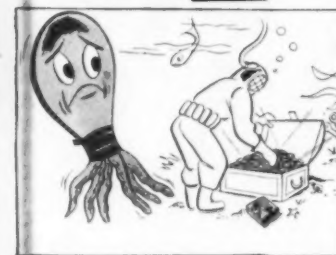
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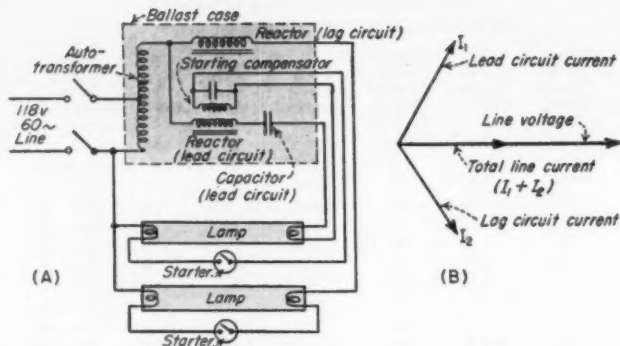


FIG. 5—Wiring diagram for a two-lamp high power factor ballast (A) for 30-watt and larger preheat type fluorescent lamps, and current and voltage relations (B).

unity. These current and voltage relations in a two-lamp ballast are shown in Fig. 5-B.

Another advantage of both the two-lamp and three-lamp high power factor circuits is the reduction of the stroboscopic effect. The light from a fluorescent lamp is almost completely extinguished twice each cycle, or 120 times a second on a 60-cycle supply. This causes a stroboscopic effect which is objectionable in some lighting installations. In the two-lamp as well as the three-lamp circuits, Figs. 5-A and 6, the lamps are out of phase with each other; thus the stroboscopic effect is greatly reduced.

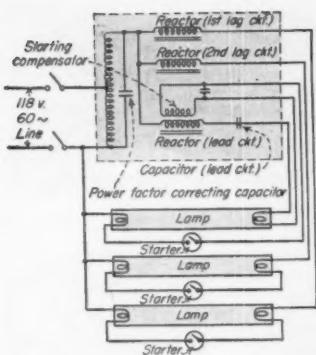
Because the lead circuit is predominately capacitive it has, as do all capacitance circuits, a constant-current characteristic. In order that the lead circuit lamp receives sufficient cathode

pre-heat (starting) current, a starting compensator is necessary. As shown in Fig. 5-A this compensator, for compactness, is usually wound on the core of the lead circuit reactor. It is simply a reactor and is connected in series with the lead lamp starter. Its function is to cancel some of the capacitive reactance of the circuit during starting condition. The compensator is important for satisfactory lamp life and positive starting of the lead lamp. Only the two-lamp and three-lamp high power factor ballasts, 30 and 40 watt sizes, require a starting compensator. The small capacitor across the compensator is for the suppression of radio interference. The 85-100 watt lamp has an arc current sufficient for proper cathode preheating, so the ballasts for the operation of that size lamp do not require compensators.

TABLE II—OPERATING CHARACTERISTICS FOR SLIMLINE FLUORESCENT LAMPS

Lamp Size	Normal Lamp Wattage (Watts)	Lamp Diameter (Inches)	Normal Lamp Length* (Inches)	Lamp Current (Amperes)	Lamp Voltage (Volts)	Starting Voltage (Volts)
42T6-	18	3/4	42	.120	175	450
	25	3/4	42	.200	150	450
	33	3/4	42	.300	130	450
64T6-	27	3/4	64	.120	270	600
	39	3/4	64	.200	230	600
	51	3/4	64	.300	200	600
72T8-	26	1	72	.120	240	600
	38	1	72	.200	220	600
	51	1	72	.300	200	600
96T8-	34	1	96	.120	320	750
	51	1	96	.200	295	750
	69	1	96	.300	265	750
96T12-	75	1-1/2	96	.430	195	700

(\* Includes lamp and two standard lamp holders).



**FIG. 6**—Wiring diagram for a three-lamp high power factor ballast, for 30-watt and larger preheat-type fluorescent lamps.

Fig. 6 shows the circuit for the three-lamp high power factor ballast. As seen in the diagram, it consists of a lead circuit and two lag circuits with a common autotransformer. It also has an additional power factor correcting capacitor, across the autotransformer, which is necessary because of the additional lag circuit.

Thus far only ballasts for the operation of switch start type fluorescent lamps have been discussed; i.e., lamps requiring starters. A more recent addition to the family of fluorescent lamps is the slimline group. This group consists of lamps which are, in general, longer and smaller in diameter. They have the feature of instant starting and so require no starters. Operating characteristics of the slimline series are given in Table II. These lamps range in length from 42 to 96 inches and from  $\frac{3}{4}$  to  $1\frac{1}{2}$  inches in diameter. The lamp wattages are from 18 to 75 watts. Note in the Table that the minimum starting voltage, to accomplish instant starting, and starting without the aid of a starter, is considerably higher than the voltages required for the starting of the switch-start type lamps. No starting compensator is necessary in the slimline ballasts. Otherwise the construction is the same as that of the 30- and 40-watt ballasts except that the autotransformer has a higher-turns ratio for the higher required output voltage. Fig. 7-A and 7-B show typical single and two-lamp high power factor slimline diagrams. The high output voltage of the slimline ballasts creates a safety hazard. This hazard is remedied by the special construction of the lampholder.

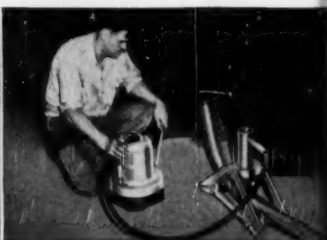
No discussion of fluorescent ballasts is complete without some mention of the Certified Ballast Manufacturers program. A number of ballast manufacturers have formed a group for the purpose of maintaining quality stand-

# 5 WAYS to slash costs on conduit installations



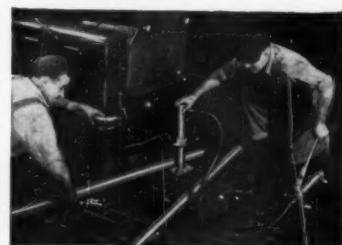
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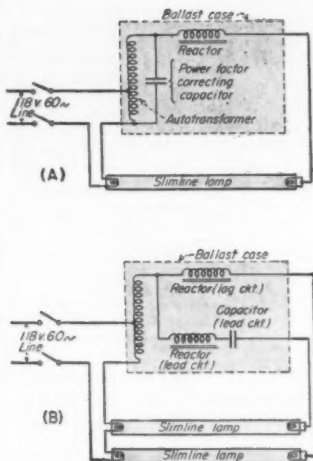


FIG. 7—Wiring diagrams for typical single lamp (A) and two-lamp (B) high power factor ballasts for instant-start slimline lamps.

ards on ballasts for fluorescent lamps. They have set up recommended minimum requirements for ballast performance which are under the heading of Specification No. 6 for Fluorescent Lamp Auxiliaries. Membership in this group is open to all ballast manufacturers.

Specification No. 6 gives limits for lamp current, wattage delivered to the lamp or lamps by the ballast, and wave shape (peak to RMS ratio). It also gives the limits for lamp starting voltage and starting current in the case of ballasts for lamps requiring starters. Specification No. 6 not only suggests that ballasts must comply with Underwriters Laboratories standards, but it also set forth ballast heating limits. It provides that no part of the ballast case should have a temperature rise of greater than 50 degrees Centigrade when operated with a lamp short-circuited, in an ambient of from 35 to 45 degrees Centigrade. The later condition is to stimulate a failed starter condition.

The growth of fluorescent lighting since its commercial beginning in 1938 has been meteoric, yet much remains to be learned about the operation of the individual light sources under varying conditions. This discussion has dealt only with the fundamental problems and design considerations which are common, in general, to any fluorescent lamp ballast. A full understanding of these problems will aid in the operation and maintenance of ballasts and transformers for fluorescent lighting systems and pave the way for an appreciation of future developments which will be made in the years ahead.

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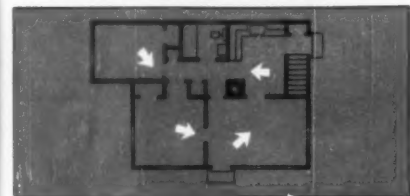




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# Product News



## Motor

(1)

For use where a constant-speed high-torque single-phase motor is required in large ratings, a new repulsion-induction motor has been announced. An addition to the Tri-Clad line, the new motor combines high starting torque of repulsion motor with constant-speed characteristics of induction motor. Designated as Type SCR, it is available in 5, 7½, and 10 hp. ratings, all 1800 rpm. The 5 hp. unit operates on 115/230 volts, while the other two use 230 volts. Typical applications include air and refrigeration compressors, pumps, stokers, floor surfacers, and farm uses. Motor is of open (dripproof) type.

General Electric Company, Schenectady 5, N. Y.



## Dimmers

(2)

New Radiastat dimmers for lighting control purposes in theatres, auditoriums, churches, colleges, schools, etc. have been announced. Designed primarily for lamp dimming, they are also suitable for industrial or laboratory use where ac voltage applied to loads must be adjustable. Unit is essentially a core type autotransformer, and can control any lamp load from 5 watts minimum up to maximum rated wattage. Available in two sizes,

13 and 15½ inch diameter with maximum load ratings of 5500 and 8000 watts respectively on 110-120 volt, 50-60 cycle service. Features include circular metal base plate, toroidal coil and core, solid brad contacts, multiple silver-graphite shoe, oilless center bearings, low core loss and protection against excessive circulating currents.

Ward Leonard Electric Co., Mount Vernon, N. Y.



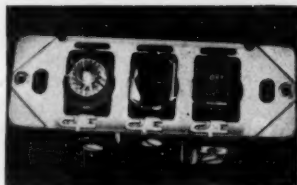
INCANDESCENT SPOTLIGHT fixtures known as Trimspot, to match fluorescent Trimline series have been announced. Each fixture is equipped with one or two 150-watt PAR-38 spot lamps which can be rotated in a 360° arc and tilted up to an angle of approximately 20°. Either single or double spotlights can be placed between two fluorescent units, at intersecting corners of fluorescent fixtures or at end of a row of lighting. Manufactured by Sylvania Electric Products Inc., 1740 Broadway, New York, N. Y.

## Cable Equipment

(4)

A new unit has been added to this line of cable sectionalizing equipment. Device combines a load break oil switch with a set of three gang-operated oil fuse cutouts to provide fuse protection to a load which can be fed from either of two feeders. Oil fuse cutouts permit isolation of load without interrupting loop circuit continuity and oil switch includes provision for isolating and grounding either feeder without disturbing service to the load from the other. Switch mechanism and cutout connections are enclosed in a welded steel, oil filled tank. Standard units are furnished with cutouts rated at 2500, 5000 and 8000 volts, and 400 ampere load break switches rated at 7500 or 15000 volts.

G & W Electric Specialty Co., Inc., 7780 Dante Avenue, Chicago 19, Ill.

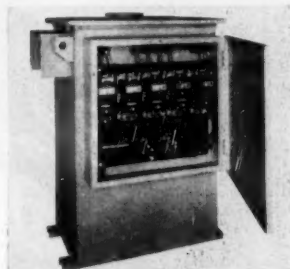


## Mounting Strap

(5)

The new P&S-Despard Camtrap replaces the older type Despard mounting strap. Three operations are required to lock wiring devices in Camtrap. The cam is opened, device inserted and cam closed, locking device securely in place. Devices can be removed, speeding interchanging, with no strap distortion. Complete operation is done with fingers. Camtrap will accommodate all Despard devices.

Pass & Seymour Inc., Syracuse 9, N. Y.



## Control Regulator

(6)

A new brightness control regulator designed specifically for controlling series airport runway lights has been announced. It is Type CCRBL and built to CAA specification L828. Some of the advantages are high speed switching under loads so lights will not go out while changing brightness taps; resonant circuit eliminates surges to lamps; power factor is approximately 99% full load; brightness control relays and regulator come completely wired in one case; four to six cycle open circuit protection is positive and quick acting; low voltage, under 600 volts, in relay cabinet; interlocks on contactors prevent transformer windings becoming shorted. Available in 7½; 15; 20 and 25 kw.

Hevi Duty Electric Company, Milwaukee 1, Wis.

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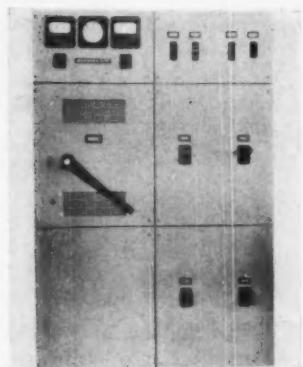
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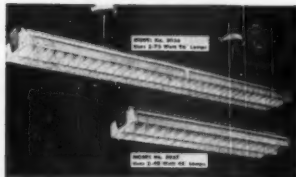


## Switchboard

(7)

A new distribution switchboard, designated "Building Type", specifically designed for controlling low voltage distribution circuits, 600 volts and under, is available. Suitable for office, commercial and institutional buildings. It uses a universal frame consisting of six basic components. Flexibility is obtained by square-hole punchings at regular intervals in all six parts permitting final assembly by bolting. Using this assembly method, busbars, circuit breakers, instrument transformers, and other devices may be located within switchboard as indicated by circuit requirements and preferred circuit breaker arrangements. Built in two overall heights, 75½ inches and 90½ inches, including bottom mounting plate and top cover. Fixed-type air circuit breakers are used in ratings from 15 to 4000 amperes continuous.

Westinghouse Electric Corp., Pittsburgh 30, Pa.



## FLUORESCENT LIGHTING FIXTURES

designed for school or office use have been announced. Available in 4 and 8 foot fixtures, with and without louvers. Construction is of all steel. Push type lampholders and 2-position louvers are taken out or replaced by one man. The 4-foot fixture uses 2—40 watt T-12 single pin lamps and 8-foot fixtures uses 2—75 watt T-12 single pin lamps. Made by Mitchell Manufacturing Company, 2525 Clybourn Avenue, Chicago 14, Ill.

## Lighting Fixture

(9)

Announcement has been made of a new "Dreadnaught" series of two lamp slimline fluorescent fixtures for commercial and industrial use. They incorporate high efficiency lighting, compact, streamlined design and sturdy construction with the turret socket. Sockets permit use of 120, 200, 300 and 430 ma ballast and are adaptable to either T6, T8 or T12 single pin slimline lamps. Available in seven different sizes. Units are finished in white plastic-base enamel. Decorative end plates of specially-plated aluminum with embossed design.

Metacraft Products Company, Inc., 306-308 Cherry Street, Philadelphia, Pa.



service include several exclusive design features—a full cover interlock that locks switch "on" or "off". Cover can be locked, with 1, 2, 3 or 4 padlocks of varying sizes and shapes. Current carrying parts are silver plated, and blades are visible for quick checking of switch operation. Line terminals are dead-front, protected by a hinged arc chamber. Quick make and break action is assured by the simple mechanism with no dead center. A magnetic plate in arc chamber cover adds to the high rupturing capacity of new switches. A non-tracking insulation is used in the base. Pressure connectors are removable. Types C and D switches for standard industrial duty and general purpose duty respectively are similar in appearance and dimensions to Type A, with design and construction details differing to meet service demands.

Square D Company, 6060 Rivard Street, Detroit 11, Mich.

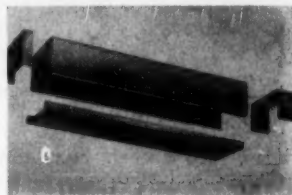


## Phase Converter

(10)

Announcement has been made of a new phase converter, which makes possible the use of 3 phase 220 volt motors on single phase 220 volt power lines. It maintains high efficiency while increasing power factor. Converters are designed for use with 3, 5 or 7½ hp motors, with special sizes furnished on order for motors up to 40 hp. Fuse blocks are standard equipment. Heavy duty, non-fusible toggle switches make separate motor starting controls unnecessary. For use by farmers and small shop or factory owners in rural and suburban areas.

Henry Electric Co., Saginaw, Mich.



## Wireway

(12)

A new 4 inch by 6 inch flangeless wireway, equipped with screw type cover for convenience in use has been added to this line of electrical wiring installations equipment. Available in standard lengths of one, two, three, four and five feet, wireway is intended primarily for use in connecting meter-board and for other similar wall-type wiring where its rectangular dimensions offer installation advantages. It is also suitable for use on a wide range of applications where heavy wires are required.

Keystone Manufacturing Company, 23328 Sherwood Ave., Center Line, Mich.

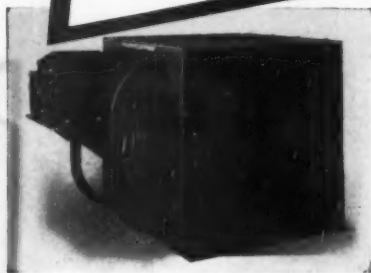
## Safety Switches

(11)

The newly designed 100 and 200 ampere safety switch line is in production. The larger size switches conform to the general design features of 30 and 60 ampere sizes. Type A switches for heavy duty industrial

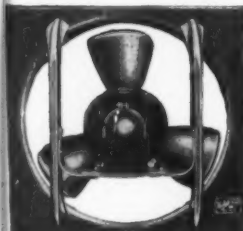
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**DISK FANS**



"BUFFALO" BREEZE FAN

"Buffalo" "L" Breeze Fans are ideal "package" units for exhausting vapors, fumes and gases. Light, simple to install. Motor protected from air stream. Handy side inspection door. 12" to 36" sizes for as high as 7300 cfm. at 1/4" static.

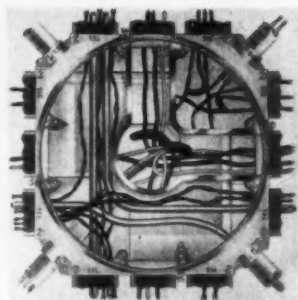
"Buffalo" Breeze Fans are quickly installed in walls where you need to exhaust fumes, heat, dust for health and comfort. 6 sizes, 8" to 24". WRITE FOR BULLETIN 3222-F, for facts on the profitable, top-performance line!

## BUFFALO FORGE COMPANY

520 BROADWAY BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Branch Offices in all Principal Cities



Junction Boxes

(13)

A new series of three, shallow, pan-type junction boxes for "Nepcoduct" one, two or three duct underfloor wiring systems has been announced. Designed for installation with shallow concrete slabs, open-web steel joist construction, steel decking, or cellular floors, the boxes occupy only 2 1/2 inch of top floor construction. All ducts enter on one level, with an interior design placing low potential wiring area at top level of box. They are provided with adjusting screws for raising, lowering and levelling. Pan-type boxes have hand-holes. Ducts and conduits are secured to boxes by tangent bearing set screws. Listed by Underwriters' Laboratories, Inc.

National Electric Products Corp., Chamber of Commerce Bldg., Pittsburgh 19, Pa.

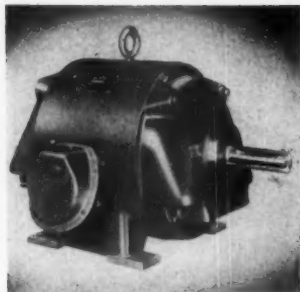


Ground Clamp

(14)

An improved type of ground clamp which fits either water pipe or ground rod, is now being produced. Known as "Sherman GF13-B", clamp resembles the conventional type, but has a specially shaped bottom section which may be installed either side up, thus adapting it to a wide range of pipe and rod diameters. Ground connections may be made to pipe ranging from 1/4 inch to 1 inch diameter, and to rods from 3/8 inch to 1 inch diameter. It is made of heavy cast bronze and recommended for use on copper pipe, as well as galvanized pipe or iron rods.

H. B. Sherman Manufacturing Co., Battle Creek, Mich.



#### Splash-Proof Motors (15)

New splash-proof type CSP life-line induction motors are available. These squirrel-cage motors are designed for constant speed applications both indoors and outdoors. Protected from dripping or splashing liquids by solid rolled-steel frames and baffles in end brackets. Motors are equipped with prelubricated bearings. Typical applications include food-processing plants, chemical plants, boiler rooms, laundries, oil fields, refineries and similar places where splashing liquids are encountered. Available in 7½ to 100 hp.; 60, 50, 25 cycles; 208, 220, 440, 550, 2300 volts.

Westinghouse Electric Corp., Pittsburgh 30, Pa.

(16)



"SKYLINE", a new concept of electric lighting with all the advantages of incandescent plus the appearance of fluorescent, has been announced. An adaptation of silvered-bowl incandescent lighting, it is designed for commercial use. Output can be varied from 2,500 to 10,000 lumens per unit by use of 150-, 200- or 300-watt lamps. Units, 24 inch by 24 inch, can be recessed in lines, in threes, or in checkerboard arrangement. Unit can be surface-mounted. Manufactured by Silvray Lighting, Inc., 1270 Sixth Ave., New York, N. Y.

#### Pulley (17)

An automatic variable speed clutch pulley controlled by engine speed, infinite gear ratio changes on which speed belt can be used has been developed. Clutch is centrifugally oper-

# RAWLPLUG

is the trade name of  
**ONLY the ORIGINAL and GENUINE!**  
All others are imitations\*

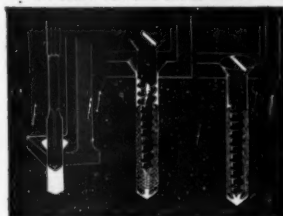
The word "RAWLPLUG" used in connection with *Jute Fibre Screw Anchors* is exclusively the property of The Rawlplug Company, Inc. For forty years it has been secured to them by common law and by trade mark registry. It is the corporate and trade name of the company and specific product of their manufacture.



## \*Substitutes

**CAN PROVE DANGEROUS!**

Buy—Stock—Sell and Use *Only* the Original and Genuine RAWLPLUGS... There are many imitations... so look for the trade mark "Rawlplug" on the Blue Box.



RAWLPLUG eliminates extra troublesome spotting or layout work... with RAWLPLUG just drill through the hole in the fixture to be fastened, insert the plug and drive the screw home.

RAWLPLUG Holds Better... because the flexible jute fibre construction permits complete conformation to all irregularities the entire length of the hole drilled.

RAWLPLUG Lasts Longer... because of the vital 100% chemical impregnation against any form of deterioration.

RAWLPLUG May Be Used In... Plaster—Brick—Concrete—Cinder Block—Stone—Hollow Tile—Plastics—and a very long list of materials for various purposes too long for space to permit listing...

RAWLPLUG Weighs Less, Costs Less, and Holds More... There is a size and length RAWLPLUG for every wood screw...

SO...

"IF YOU DON'T USE RAWLPLUGS... THERE'S A SCREW LOOSE SOMEWHERE"

12K12

For further information write Dept. E

### The Rawlplug Company, Inc.

271 Church Street, New York 13, New York

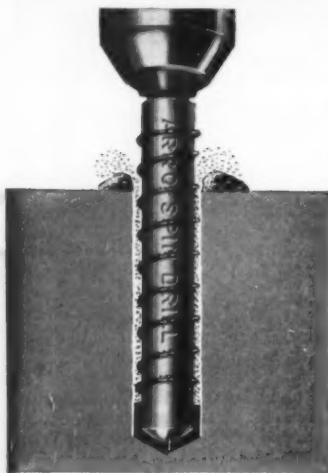


THERE ARE RAWL

... EXPANSION BOLTS, SCREW ANCHORS AND MASONRY DRILLS FOR EVERY NEED. SOLD THROUGH ALL LEADING HARDWARE, ELECTRICAL AND MILL SUPPLY HOUSES



## Flexo-Flute SPIN DRILLS FOR ALL MASONRY



- **CLEANS DUST FROM HOLES AUTOMATICALLY**
- **DRILLS FULL DEPTH WITHOUT STOPPING**
- **MAKES FASTER CLEANER CUTS**

Low-angle flexible spring "pops" drill cuttings out of hole automatically. Drills full depth without removing drill . . . no packing or binding. Genuine Carboloy Cemented Carbide tip.

### OTHER NEW PRODUCTS



#### DOUBLE EXPANSION SHIELD

Used with machine bolts . . . made for attaching to all types of solid masonry. Bolt sizes:  $\frac{1}{4}$ " through  $1\frac{1}{4}$ ".



#### STUD BOLT ANCHOR

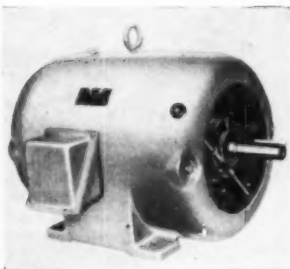
Consists of cone headed steel bolt and nut, lead sleeve, and hard metal cone expander in  $\frac{1}{4}$ ",  $\frac{3}{8}$ " and  $\frac{1}{2}$ " diameters—in various lengths.

**SOLD ONLY THROUGH JOBBERS**

**ARRO EXPANSION BOLT CO.**  
MARION, OHIO

ated. In one of two pulley halves, which operate along a central shaft connected to engine, are several steel balls. When speed of engine is increased, centrifugal force pushes against pulley half, forcing halves together, carrying belt up and automatically changing from a low to high speed ratio. Belt revolves on other end on a similar pulley which operates by spring action. Varying performance, reduction or acceleration of starting and running speeds, may be obtained by inserting larger or smaller steel balls. Automatic clutch pulley allows for independent action of pulley belt by means of an intermediate ball bearing.

*Drive-Way Lite Co., Denver, Colo.*



### Motors

(18)

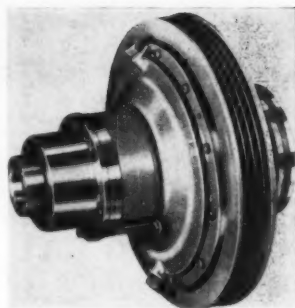
Announcement has been made of the development of a full line of cast iron frame totally enclosed fan-cooled motors, available in ratings from 5 hp through 250 hp in both standard and explosion-proof designs. They are especially suitable for applications in chemical plants, oil fields, petroleum refineries, etc. where corrosion is a problem. Construction details include: cast iron frame, endplates, blower shield and conduit box; corrosion resistant blower; sealed leads; cartridge type ball bearings; protected laminations; special varnish treatment; cast aluminum rotor; drain plugs.

*Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis 14, Mo.*

### Clutch

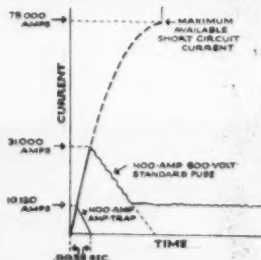
(19)

Magnetic-particle clutches for control of torque, speed and position have been announced. The Magneclutch is a controllable coupling which utilizes the linking action of a dry magnetic mixture, composed of iron particles and flake graphite. The magnetic field is established by current flowing through a coil, and by varying the



current the degree of clutching can be controlled. Operating advantages are small control power with fast response; no wear on torque transmitting surfaces; torque at zero slip; large maximum to minimum torque ratio and adaptation to remote control.

*Vickers Electric Division, Vickers Inc., 1815 Locust St., St. Louis, Mo.*



### Protective Device

(20)

A current limiting device for protection of low voltage switchgear, busways, circuit breakers, transformers and other electrical installations against short circuit damage has been announced. Known as Amp-trap, the operating principle is simple, depending chiefly upon the characteristics of certain composite link elements. Links are embedded in sand. When a short circuit current develops in circuit, the silver link quickly melts and partially vaporizes, breaking circuit in a matter of micro-seconds. Furnished in various models and ratings to match electrical characteristics of old and new power installations. They have high interrupting capacity regardless of their current carrying capacity.

*Chase-Shawmut Company, 374 Merimac St., Newburyport, Mass.*

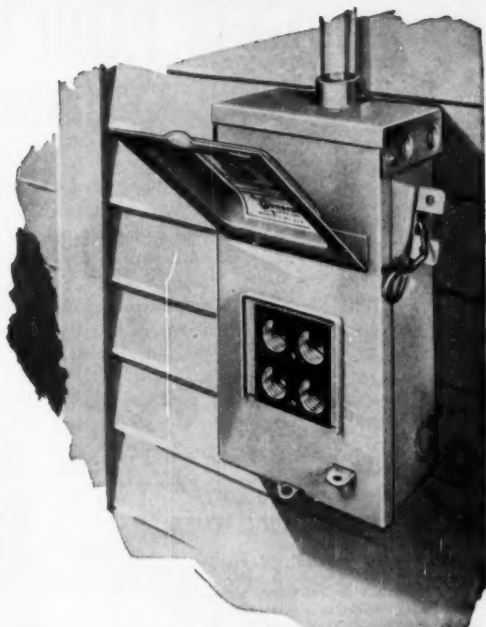
# The Switch is to General for Outdoor Service

Single and Double  
Pullout  
Combinations

Front Operated  
Toggle  
Combinations


100 Amp  
Fusible Main  
Service Equipment

30 to 1200 Amp,  
HP rated  
Safety Switches



R33NP4  
Side Operated  
Plug Fused  
Service Equipment

## General makes a complete line of Weatherproof and Raintight Service Equipment and Safety Switches

THE next time take a good look at  General's outdoor equipment—recognized as one of the most complete lines of service entrance equipment and safety switches.

Enclosures made of *Zincgrip* steel are finished with a machine gray baked enamel for thorough protection against weathering—Dependable hinge design

safeguards interiors from rain, sleet or snow—Ample knuckle room and abundant knockouts are provided for convenient wiring.

These and many more distinctive features will be apparent to you immediately upon examination—sold everywhere exclusively through wholesalers.

Write for our latest catalog 4809—and supplement 4911

 **General**  
Switch Corp.

49 Roebbling Street Brooklyn 11, N. Y.

One of the largest Manufacturers of:

#### SERVICE ENTRANCE EQUIPMENT . . .

Pullout, Front Operated Toggle and Side Operated types.  
Indoor—surface or flush, and Outdoor.

#### ENCLOSED SAFETY SWITCHES . . .

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Indoor and outdoor. HP rated.

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# FOR GREATER PROFITS

get your share of the growing market for **PAINE** hanging and fastening devices



## EXPANSION ANCHORS for solid walls or floors

The tough job of fastening articles to solid floors and walls is easily licked with Paine Expansion Anchors. Used in any solid material.



## PAINE HANGER IRON 1001 Home Uses

Paine Hanger Iron is one of the most useful home fix-it items on the market today. It can be bent or twisted to fit the user's needs for hanging innumerable items.

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## SPRING WING TOGGLE BOLTS

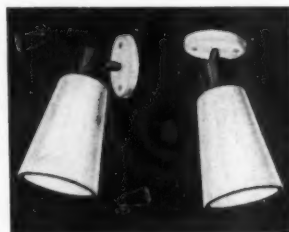
Provide permanent fastening to hollow walls or ceilings the simple and inexpensive way. They may be used for fastening to wood, marble, lath and plaster, gypsum, tile and sheet rock.



## Loomwire (21)

Two improvements in the design of canvas-back loomwire, a non-metallic sheathed cable has been announced. The No. 14 and No. 12 cable, with Type T or Type R conductor insulation, have a "frosty finish", which allows the cable to be handled or stored in warm locations without becoming tacky and improves the ease of installing the cable. Stripping is improved due to insertion of a paper dam completely around the conductor assembly, under the sheath. These changes improve the moisture and flame-resistant qualities of the canvas-back loomwire protective braid. Listed by Underwriters' Laboratories, Inc.

National Electric Products Corp., Chamber of Commerce Building, Pittsburgh 19, Pa.



## (22)

**DISPLAY LIGHTS** with angle cut-off, and universal swivel have been announced. They have fingertip adjustment. Available in four mounting types, side or straight, surface or stem. Angle cut-off hood changes light beam to an asymmetric pattern. Take R40 floor or spot lamps. Finished in two tones — hood aluminized, neck in black. Approved by Underwriters' Laboratories. Manufactured by Garden City Plating & Mfg. Co., 1750 N. Ashland Ave., Chicago 22, Ill.

## Connectors (23)

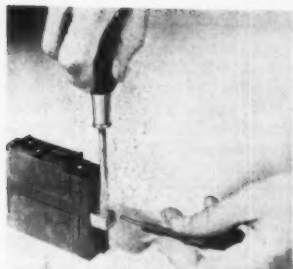
Announcement has been made of new "Fas-Test" connectors, a simple method for numerous wire connections. They consist of two parts, a bronze

**The PAINE CO.** 2961 Carroll Ave., Chicago 12, Ill.

Offices in Principal Cities

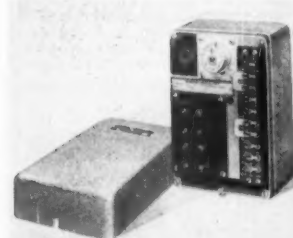
The Best Craftsmen Always Take

**PAINE'S**



collar and screw or a bronze collar and nut. Insert one or two wires, turn down the screw or nut and the wiring job is done in a matter of seconds. They can be mounted on the stud and one or two wires can be clamped by means of brass nuts. Sidewalls keep wires in place. Two sizes are available, FT10 wire range 10, 12, 14, 2 No. 12, 2 No. 14; FT8 wire range 8, 10, 12, 14, 2 No. 10. These are approved where acceptability of combination has been determined by Underwriters' Laboratories, Inc.

*Ilco Copper Tube & Products, Inc., Cincinnati, Ohio*

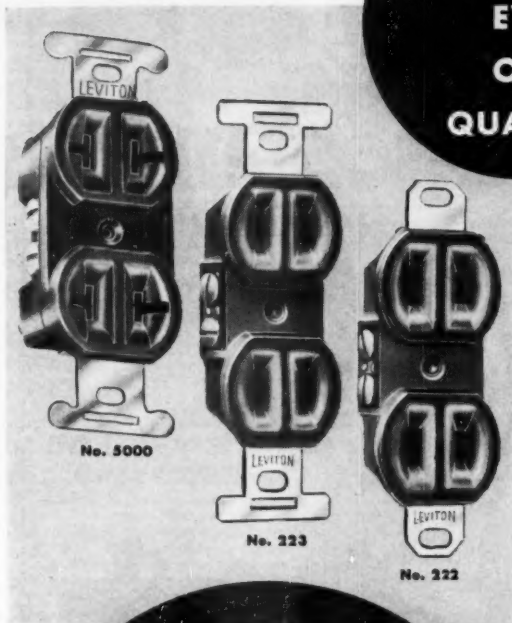


#### Electronic Timer

(24)

A new electronic timer which provides automatic control of operation, limit, and sequence timing for many industrial processes has been announced. It is available in three time ranges: .06-1.2 seconds, .6-12 seconds, and 6-120 seconds. Some applications are: operation timing to control duration of such processes as paint spraying, electroplating and heat treating; limit timing to stop conveyor belts if material piles up; sequence timing with two or more timers in combination to control duration of operations on bearing-grinding machines, rod-coiling machines, illuminated signs, etc. It features a detachable back plate which mounts directly on a rigid conduit or any flat surface.

*General Electric Company, Schenectady, N. Y.*



**KEEP  
YOUR  
EYE  
ON  
QUALITY**

No. 5000

Rated: 15A-125V  
10A-250V

Duplex Receptacle

T-Slotted, Double contact

In brown or ivory  
Meets R. E. A.,  
C. S. A. and  
Federal specifications.

No. 233-222

Rated: 15A-125V  
10A-250V

Duplex Receptacles

Parallel Slots

In brown or ivory  
with or without  
plaster ears

#### A FINE LINE OF PERFORMERS

You can depend on Leviton devices for good performance wherever used. From the simplest to the most intricate, every Leviton device is accurately engineered and precision built to do its job.

And the Leviton line is complete — every type in various styles—at a price to fit your project.

*See the complete Leviton line  
at all leading distributors*



### LEVITON MANUFACTURING COMPANY

MAIN OFFICE and FACTORY: BROOKLYN 22, N. Y.

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QUICKLY MAKES

ON-THE-JOB BENDS IN

CONDUIT, PIPE, TUBING

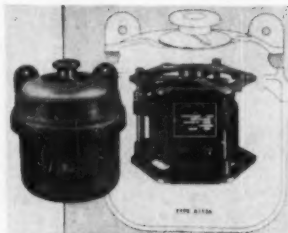


### GREENLEE HYDRAULIC BENDER

With this timesaving GREENLEE Bender one man easily makes smooth, accurate bends in just a few minutes—in rigid and thin-wall conduit, pipe up to 4½", tubing, bus-bars. Compact, portable—lets you make bends right on the job *when and where needed*. Saves labor, eliminates cost of many manufactured bends and fittings. Owners report 50% to 90% timesavings, say it often pays for itself on first few jobs. Write today for free folder E-206. Greenlee Tool Co., 1748 Columbia Avenue, Rockford, Illinois. U. S. A.



Other GREENLEE timesaving tools for electricians: Hand Benders • Knockout Tools • Cable Pullers • Boring Tools and many others.



### Explosion-proof Powerstats (25)

These new explosion-proof powerstats provide a safe means of obtaining a continuously-adjustable source of ac voltage in hazardous areas where a small arc or space could cause an explosion. Unit consists of a variable transformer totally enclosed in a case which will withstand internal gas or vapor explosions. They carry Underwriters' approval for Class 1, Group D service. Various types are available in 115 and 230 volt ratings for single phase operation.

Superior Electric Company, Hannon Avenue, Bristol, Conn.



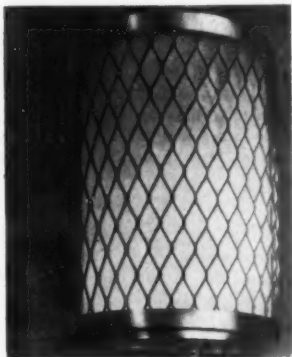
### Dual Control Service (26)

A new dual control service equipment provides two separate circuit-protective units in one 16-gauge corrosion-proofed steel enclosure. Developed primarily for use in rural areas, unit has one set of magnetic breakers for main disconnect of all service equipment and one set of magnetic breakers which can be used as a separate system for control of waterpumps, fire-fighting equipment, outdoor lighting, barn or any other special circuits. Black handles indicate main disconnect and red handles mark disconnect for secondary circuits. Enclosure contains one 50 ampere, two-pole circuit

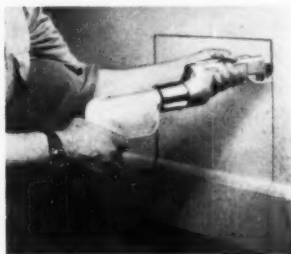
breaker for main service and one 20 ampere, two pole unit for auxiliary service. Other breaker ratings or combination of ratings are available. Overall height measures 15 inches, width 6¾ inches and depth 3½ inches.

Heinemann Electric Company, Trenton, N. J.

(27)



**GUARDED LIGHTING FIXTURES** suitable for schools, institutions, industrial plants and shops, where breakage creates a hazard, are being manufactured by Strickley & Company, 2404 West Seventh St., Los Angeles 5, Calif.



### Power Saw (28)

A new portable all-purpose saw has been announced. Known as the Tri-Saw, it cuts directly into floors and walls without a starting hole. Cuts wood, sheet metal, heavy metal, nails, pipe, etc. Fits any ¼ inch electric drill. Can be used with regular hacksaw blades.

Tri-Saw Corporation, St. Louis, Mo.

### Switch Box (29)

A new switch box, called Levelock, has been announced. Designed for faster installation, box has a new, improved locking mechanism that

**NOCRETE**  
WITHOUT CONCRETE  
ENCASEMENT

VOL. 1 NO. 3

# ORANGEBURG

## Fibre Conduit News

**STANDARD**  
WITH CONCRETE  
ENCASEMENT

AUGUST 1950

# MORE DESIGN ENGINEERS SPECIFY THIS CONDUIT

## For One and Two-Duct Jobs—NOCRETE



More contractors than ever appreciate the profit possibilities of NOCRETE for single or double duct runs. For when conditions favor its use, NOCRETE—installed *without* concrete encasement—*saves time, work and money*—in such installations as factories, schools, colleges, hospitals, drive-in theaters, power, telephone and other communications systems... also service entrances, parkway and suburban lighting, airport lighting and communication.

## Easily Tooled on the Job



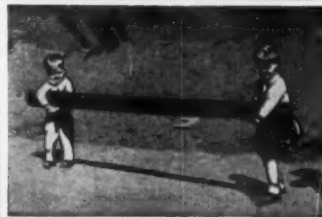
Orangeburg can be worked right in the field. It is easily tooled and can be sawed to any length. It saves time, makes work lighter for the crew. Contractors save by its use, make better net profit.

## 57 Years' Record of Success

Orangeburg started in 1893. Its quality and durability are *proved*. Today it is standard practice for public utilities, municipalities and industry to use Orangeburg Fibre Conduit when installing cables underground. Orangeburg is leader and first choice in every city and state.

**ORANGEBURG MANUFACTURING CO., INC., ORANGEBURG, NEW YORK**

**Graybar**  
ELECTRIC COMPANY



## SO LIGHT A CHILD CAN CARRY IT

Standard 4" weighs only two pounds per foot and even *Nocrete* with its heavier wall weighs but four pounds per foot in the 4" size. Think what this lighter weight means. It means lower transportation and handling costs, speedier installation.

## ORANGEBURG'S OUTSTANDING ADVANTAGES

These advantages have met with wide acceptance. Each year finds more and more contractors, design engineers, utilities and municipalities turning to Orangeburg for the permanent and economical installation of electrical services underground.

1. Will not corrode. Lasts indefinitely.
2. Impermeable wall and tight joints prevent corrosive ground waters from entering.
3. Lays faster and at lower cost than any other type of conduit.
4. Low coefficient of friction keeps pulling tensions on cable to minimum.
5. Protects cable sheath from abrasion when pulled in—also from wear during cable movement resulting from alternate expansion and contraction with changing loads.
6. Resists acids, alkalis, salt, grease, oil.
7. Light, easy to handle and tool on the job.
8. Tough, resilient—will not crack or break when properly handled.

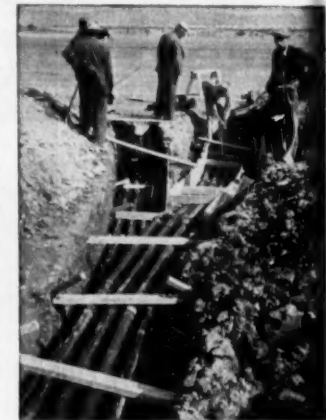


## TAPERED SLEEVE JOINTS PREVENT INFILTRATION

...of corrosive ground waters. Easily assembled, with Tapered Sleeve Couplings, these joints are permanently watertight.

## For Multiple Duct Jobs—STANDARD

ORANGEBURG STANDARD—installed *with* concrete encasement—is the economical construction where duct banks of three or more ducts are involved. In *all* installations, from single to multiple, Orangeburg lays faster, at lower cost, than any other type of conduit.



NOW BRANDED WITH  
**ORANGEBURG**  
TRADEMARK



## Send for Free Bend Section Folder

Illustrated folder—showing various types of Orangeburg Bend Sections and Angle Couplings—sent **FREE** on request. Write today to Dept. E-8, Orangeburg Manufacturing Co., Inc., Orangeburg, N. Y.

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ORANGEBURG  
FIBRE CONDUIT

GENERAL  ELECTRIC  
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# AUSTIN ELECTRICAL TAPES

FOR CONTRACTORS, LINEMEN, CENTRAL STATIONS  
AND THE ENTIRE ELECTRICAL INDUSTRY



**Electrical Friction Tape**  
Retains its soft sticky qualities—won't dry out on the roll or on the job. Sticks fast, lies smooth, holds tight. Has high tensile and dielectric strength.

## Rubber Splicing Compound

Has strength, elasticity and long life. Self-vulcanizes into solid watertight joint, insulates against high voltages.



Both types packed in cellophane wrapped rolls in standard sizes, or in the familiar Austin blue and yellow cartons, cellophane wrapped.

**THE M. B. AUSTIN COMPANY**  
NORTHBROOK, ILLINOIS

## magno-tronic

DUAL SILVER POINT — FULLY AUTOMATIC

## FLUORESCENT STARTERS

—completely eliminate  
annoying blinking  
and flickering of dead  
fluorescent lamps!

**GUARANTEED — FOR ONE YEAR!**

**PROTECTS** — Automatic thermal relay cuts out defective lamps, eliminates annoying blinking and protects all auxiliary equipment.

**SIMPLIFIES** — Replacement of defective lamp automatically recycles starter circuit. No buttons to push — no replacement of starter.

**REDUCES COST** — Magno-Tronic starters provide exact timing of electrode heating, preventing excessive loss of emission material, thus assuring maximum possible lamp life.

**VERSATILE** — Built to operate efficiently over an extended voltage and temperature range.

Demonstration and Literature on Request.



SP-15-20 For use with 15 or 20 watt lamps.

SP-30-40 For use with 30 or 40 watt lamps.

SP-65-100 For use with 100 watt lamps.

Manufactured under U. S. PATENTS

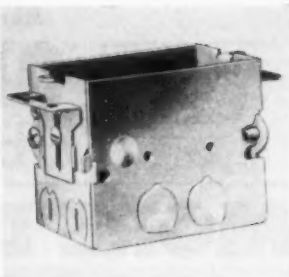
2298236	2159837	2339307
2334935	2239244	2333694
2341520		1849552

Other Patents Pending



**INDUSTRIAL ELECTRONICS CORP.**

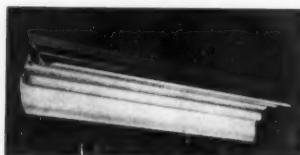
General Offices & Main Plant, 80 BANK STREET, NEWARK 2, N. J.



wedges the side plates tightly in position. An extra set of nail holes is provided for rapid mounting to studing. Four contact points on side plates allow even mounting of box with no rocking or tilting. Box is easily gangable with other boxes.

General Electric Company, Bridgeport 2, Conn.

(30)



**INDUSTRIAL LIGHTING UNIT**, Model No. 2099, using two T-12 40 watt fluorescent lamps has been announced. Unit has a 13 inch wide reflector and 5 inch hi-efficiency lamp spacing. It is designed for chain suspension, or rigid stem or rod mounting. Knockouts at either end of channel permit mounting and wiring units end to end in continuous rows. Reflector finished in glossy white baked enamel. Manufactured by Mitchell Manufacturing Company, 2525 Clybourn Avenue, Chicago 14, Ill.

## Product Briefs

(31) Shading coils or shaders for shaded pole motors are now being produced by Ilco Copper Tube and Products, Inc., Cincinnati, Ohio. . . . (32) Copperheat, a hotwater heating system, has new type radiator called Wallrads, using individual blowers. Manufactured by Copperheat Industries, Inc., Detroit, Mich. . . . (33) Holub Industries, Inc., Sycamore, Ill. has announced three new types of "Hi" fastening devices, available in 66 sizes for floors, walls and ceilings.

(34) Potter & Brumfield, Princeton, Ind., is now offering the sub-miniature telephone type series MT relays, fitted with from one to four model ISM1 microswitches. . . . (35) The new Type E tachometer generator developed



by Weston Electrical Instrument Corp., Newark, N. J. has been designed for use where there may be explosive atmospheres. . . . (36) Appleton Electric Company, Chicago, Ill., has announced a new "Goodrich" yard light which is weatherproof and designed for illumination of outdoor areas. It conforms to National Rural Electrification requirements.

(37) Roto-Beam, Chicago, Ill. has developed a new industrial radiant air wave circulator. . . . (38) Van Cleef Bros., Inc., Chicago, Ill. are offering Dutch Brand plastix tape in convenient size roles of  $\frac{1}{2}$  inch width by 150 inches long. . . . (39) Internal pipe wrenches are now available in  $\frac{1}{2}$ , 2 $\frac{1}{2}$ , 3 and 4 inch sizes. They are manufactured by Roddick Tool Company, Costa Mesa, Calif.

(40) Steber Manufacturing Company are manufacturing "Sturdiflex" heavy duty machine and bench lights, formerly marketed by the Detroit Industrial Products Company. . . . (41) A bathroom mirror which will not fog has been developed by the Charles Parker Company, Meriden, Conn. It utilizes an electric heater made of electrically-conductive rubber which was designed by U. S. Rubber Co. . . . (42) Allen B. DuMont Laboratories, Inc., Clifton, N. J. has announced the new Type 293 impulse-test cathode-ray oscillograph.

(43) A new 6 inch Thor portable electric saw has been announced by Independent Pneumatic Tool Co., Aurora, Ill. . . . (44) Blackhawk Industries, Dubuque, Iowa, offer two new yard lights, Models Nos 512 and 514. . . . (45) General Electric Co., Schenectady, N. Y. has announced a new sensitive lightmeter for measuring street lighting illumination levels.

(46) A compact, porcelain enamel-topped electric range and cabinet combination, for use in industrial laboratories, dispensaries, and offices is now available from H. J. Scheirich Co., Louisville, Ky. . . . (47) Wheelco Instruments Co., Chicago, Ill., has announced a new potentiometer controller, known as Potentirol. . . . (48) A "luxury" line of fluorescent lamps which provides a mellow white light is in production by Westinghouse Lamp Division, Bloomfield, N. J.

(49) Pennsylvania Transformer Company, Canonsburg, Pa. has added the protected pole star transformers to its line. . . . (50) Associated Lighting Service, San Francisco, Calif. has introduced Westlite's new "Touch-lock" hinge for holding faceplate and lens. . . . (51) Precision coil bobbins are now being made with a new plastic-coated core by the Precision Paper Tube Co., Chicago, Ill.

(52) A new line of high voltage selenium rectifier cartridges has been developed by the International Recti-

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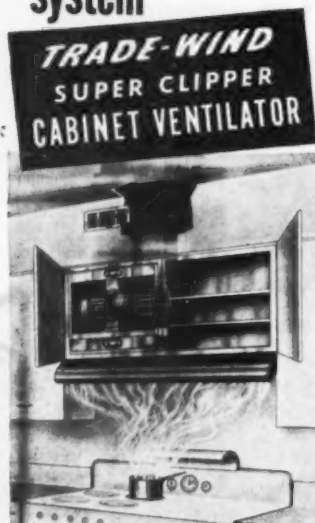
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fier Corp., Los Angeles, Calif. . . . (53) Carbology Company, Detroit, Mich. is making a carbide tipped masonry drill with a flute made of piano wire wound in a low helix around the steel shank. . . . (54) The Kirlin Co., Detroit, Mich. has announced new recessed lighting fixtures in all sizes, square or rectangular, and in fluorescent.

(55) John I. Paulding, Inc., New Bedford, Mass. is manufacturing a wall fixture including a convenience outlet. . . . (56) New single-circuit rotating-type battery-charging equipment for electric industrial trucks has been announced by General Electric Company, Schenectady, N. Y. . . . (57) The Miskella Infra-Red Company, Cleveland has introduced new lampless "chick" infra-red units made of Pyrex plate glass.

(58) Availability of neoprene-covered weather-resistant aluminum electrical conductor has been announced by Kaiser Aluminum & Chemical Sales, Inc., Oakland, Calif. . . . (59) A new type of welding cable for both

electrode and ground, known as Linconductor cable, has been announced by Lincoln Electric Co., Cleveland, Ohio.

(60) A new oil-immersed selenium rectifier especially designed for electroplating has been announced by General Electric Company, Schenectady, N. Y. . . . (61) A non-renewable, air-depolarized add-water type primary battery, known as "Carbonaire", has been introduced by Thomas A. Edison, Inc., West Orange, N. J. . . . (62) H. K. Porter, Inc., Somerville, Mass. has introduced new metal lath cutters.

(63) Millers Falls Company, Greenfield, Mass., has introduced a new rotatable blade Keyhole saw. . . . (64) A new type of telephone booth for use on construction jobs is manufactured by Burgess-Manning Company, Libertyville, Ill. . . . (65) H. K. Porter, Inc., Somerville, Mass. have introduced Co-hardite insulated tools especially designed for live work involving dangerous voltages.

## Catalogs, Bulletins and Engineering Data

(66) VARIABLE TRANSFORMER Powerstat with new brush assembly, fusing arrangement, terminal box, coil and core design is discussed in 4-page 2-color folder. The Superior Elec. Co.

(67) FASTENING DEVICES, including toggle bolts, machine screw lead anchors and expansion bolts, are specified, sketched and priced in file sheets. Holub Industries, Inc.

(68) CIRCUIT BREAKER system of new, simple, low-cost construction, is subject of 28-page presentation CB-1000-May 50. Federal Electric Products Co.

(69) PRICE SHEETS and descriptive material includes torch, outlet boxes, couplings and connectors. Appleton Electric Co.

(70) VAPOR TIGHT LIGHTING for indoor and outdoor, industrial and commercial use, is pictured and specified in 4-page folder. Paramount Industries, Inc.

(71) WELDING EQUIPMENT is discussed and analysed in pocket-size folder. Eutectic Welding Alloys Corp.

(72) V-BELTS and drives, including full-grip sheaves and multiple belting, are pictured, specified and discussed in 16-page booklet. Maurey Manufacturing Corp.

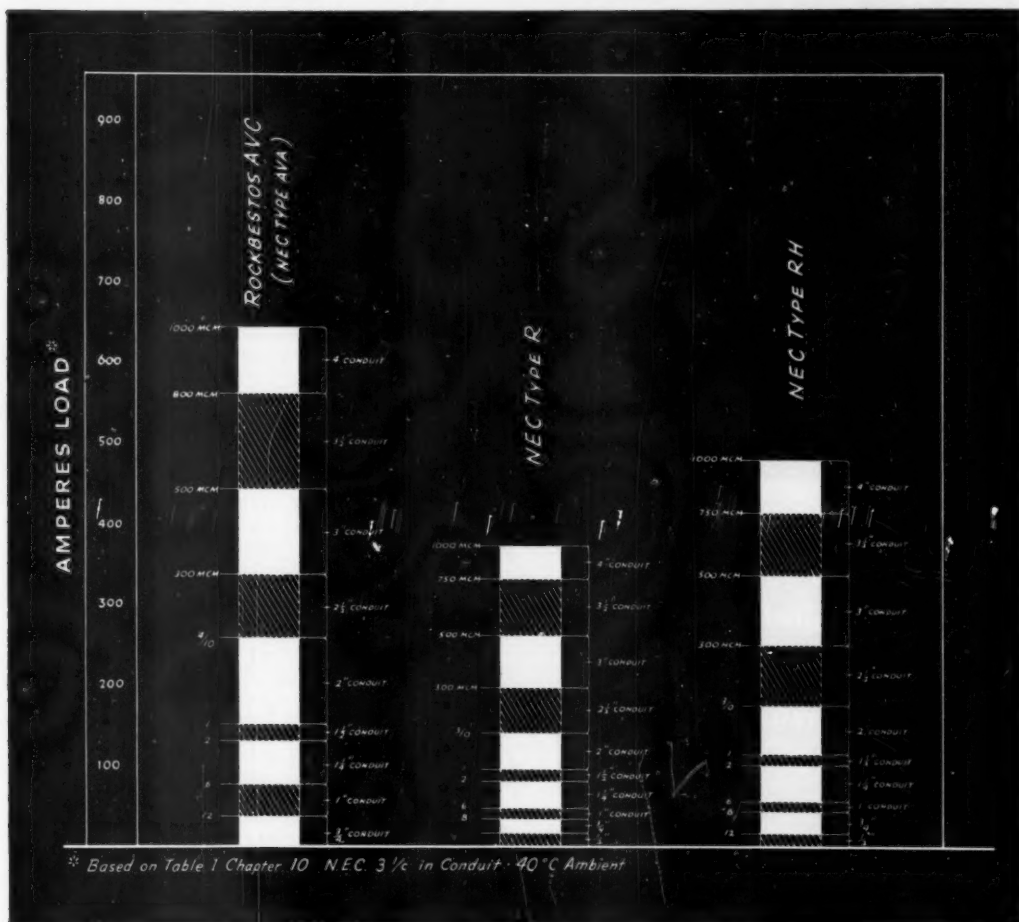
(73) PORTABLE AIR COMPRESSOR, delivering 2½ cf of air per minute at 30 pounds with ¼-hp motor, is subject of file folder. Paramount Compressor Corp.

(74) INDUCTION MOTORS and generators designed for servo applications are presented with ratings, performance curves and sectional diagrams in 2-color booklet. Arma Corp.

(75) VENTILATION KIT containing information on selection and installation of fans for cooling and ventilating homes, stores and factories, includes dimensions, photographs, descriptive material and prices. Chelsea Fan and Blower Co., Inc.

(76) PAPERWORK is discussed and suggestions for simplifying this part of the contractor's work are contained in booklet titled "Blueprint for Figure-Fact Efficiency". Remington Rand Inc.

# Are Electrical Loads Outgrowing Your Conduit?



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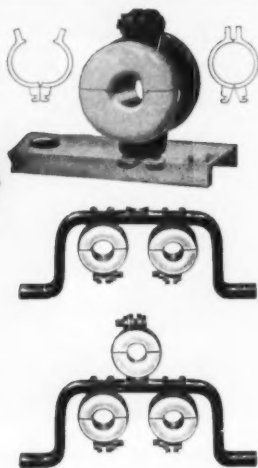
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(77) INCANDESCENT unified lighting and germicidal equipment includes data on design, square and round recessed, indirect, semi indirect and direct, general and glassware. The Art Metal Co.

(78) COOLING UNITS from 1500- to 12500-cfm capacity, for home, factory, shop and industrial use are subject of 6-page 3-fold 2-color folder. Essick Manufacturing Co.

(79) POWER PLANTS and some of their unusual applications are discussed in 16-page booklet. D. W. Onan and Sons, Inc.

(80) CIRCUIT CLOSING and opening operations, presented at college text-book level, is discussed in 56-page booklet titled "Fundamentals of AC Circuit Interruption". Allis-Chalmers Manufacturing Co.

(81) INSULATION TESTERS with higher and wider ranges for measuring time-resistance absorption are discussed in bulletin 21-20. James G. Biddle Co.

(82) AIR PUMPS, their operation and application, is subject of catalog 450 containing performance curves and specification tables. Leimay Bros, Inc.

(83) WOVEN WIRE SLINGS are priced and pictured in new booklet containing dimensions and capacities. The Cambridge Wire Cloth Co.

(84) DC MOTORS, built to specification from 1- to 500-hp, are pictured and described in publication B39-200. The Electric Products Co.

(85) LIGHTING COMPONENTS for designers and installation men, in the form of linear sections, circular accent units and adapter fittings, are presented in booklet titled "Plexoline—Imagination at Work". Day-Brite Lighting.

(86) LOUVER MAINTENANCE, a feature in new line of commercial fluorescent lighting units in 48- and 96-inch sizes, is subject of bulletin 465. Lighting Products Inc.

(87) LIGHTING FIXTURE catalog, with lighting graphs, charts and full description of units and accessories, includes wide line of fluorescent treatments. Leader Electric Co.

(88) CUTTERS for wire rope, steel rod, chain and power cables, operating by hydraulic hand-pump guillotine principle, are described in file folder. Manco Mig. Co.

(89) WIRE STRIPPER is pictured and priced on file sheet. Rockford Wire Stripper Co.

(90) TACHOMETER generators, indicators and electro-mechanical portable units are subjects of 3 file sheets. The Electro-Mechano Co.

(91) SELENIUM RECTIFIERS, with cross section views, characteristics, sizes and applications are presented in 4-page folder. Syntron Co.

(92) SWING STAGE for maintenance and construction work is described in file sheet. Wilson-Albrecht Co., Inc.

(93) ELECTRICAL CONNECTORS, such as round plugs and receptacles, lamp sockets, cable vulcanizers and distribution centers are contained in illustrated 8-page 2-color bulletin MC 108-2. Joy Mfg. Co.

(94) RECESSED FIXTURES, requiring no carpenter work or asbestos wiring, are discussed for both incandescent and fluorescent lamps. The Kirlin Co.

(95) STUD WELDING in the construction industry is discussed with drawings and text in 4-page folder. Nelson Stud Welding division of Morton Gregory Corp.

(96) SLOT INSULATORS are discussed in 3-fold mailing piece. Insulation Manufacturers Corp.

(97) CLASSROOM heating and ventilation is subject of illustrated presentation 3292-15M-5-50-GE-WP titled "37 Points of Engineering and Functional Superiority". American Air Filter Co., Inc.

(98) ELECTRON TUBES application notes discuss use of sharp-cutoff miniature pentode in television receivers. Radio Corp. of America.

(99) DIMMER, radiostat and autostat, is illustrated with diagrams, photographs and text in 16-page AIA File 31-F-17. Ward Leonard Electric Co.

(100) POWER DRIVES are pictured in jumbo-sized 8-page presentation. Sterling Electric Motors.

(101) MAGNETIC STARTER for 5 to 7.5 hp, 220 to 550v ac is presented in catalog 50. Furnas Electric Co.

(102) MEGOHM METER, dc generator type of small size and with slip clutch, is diagrammed and discussed in 2-color 4-page bulletin 465. Herman H. Sticht Co., Inc.

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**TWENTY** years bring changes--changes far greater in our fast-moving world than ever happened in Rip Van Winkle's day.

Americans are awakening to unpalatable facts--that the enterprise system which built our nation and made it strong is being subtly undermined; that advocates of backdoor socialism and communism thrive in our midst; most dangerous of all, that our young people are misinformed on economics.

For example, a recent survey of high school seniors reveals that they estimated that it takes only an \$81 investment to provide a job. Actually, as shown by the 1947 census, the 2256 establishments of the iron and steel

industry invested \$545 per worker that year alone in new plant and equipment. Total investment to provide one job runs well above \$10,000.

These youth had a similarly distorted picture of profits. They believe shareholders receive 24% of the sales dollar whereas they receive an average of less than 3%.

Misinformed minds are a ready field for imported false philosophies. And it is up to you, a business leader in your community, to take responsibility toward correcting these misunderstandings. The American businessman must not permit himself to be lost in Rip Van Winkle befuddlement.



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# Reader's Quiz

## Testing Thermal Elements

**QUESTION**—We have a lot of magnetic switches with thermal elements on all of our motors. All of these elements have their respective current ratings marked on them. I would like to know if there is any way of checking these elements inside their respective switches for current ratings, to make sure that they will trip when they are supposed to trip. Many times individuals tamper with elements and I have no way of checking up on this condition.—J. G.

**ANSWER** to J. G.—You can test your thermal elements for correct operation by putting a separate low voltage current through them and see how they respond. I have used the following method and find it easy and reliable.

Obtain the following equipment, then connect as in diagram.

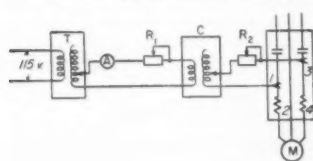
One variable voltage auto transformer, operating from 115 volts and supplying 0-about 135 volts.

One multi-ratio current transformer, with the highest range dependent upon the highest current anticipated for testing the thermal elements.

One ammeter 0-5/10 amperes.

One resistance load box.

The variable voltage auto-transformer T should be set to the lowest position of voltage. The current transformer is connected so that the auto transformer feeds the 5 ampere secondary side, and then the current transformer will act as a step-up voltage transformer, feeding a high current at a low voltage to the test leads which are connected across the points 1 and 3 of the motor starter. Of course, the power must be off the motor started. This connection will test both current elements of the starter at once, which is best as both of them will add heat to the starter. This connection

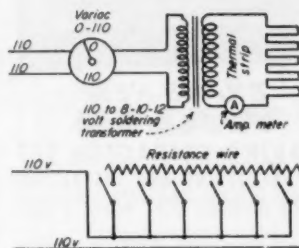


will circulate some current through the motor but will not hurt it. However, a jumper may be provided between points 2 and 4, then no current will circulate through the motor. The ammeter A measures the input to the current transformer tap ratio used. Thus, if your motor draws 73 amperes, you would probably use the 100 ampere current transformer tap. The ratio would be 100/5 in reverse, or 1:20. Set the current for motor rating for a few minutes. For 73 amperes, the ammeter should read 73/20, or 3.65 amperes. The heaters should not operate. The current should then be increased to 125% of motor rating, then 150%. Thus, the thermal elements can be accurately checked for correct operation, and the actual operating point determined. The variable resistor may be omitted, but usually one can obtain closer adjustments by its use. It may be inserted in position R1, or R2. If in position R2, it must carry the full motor current rating. At position R1, a resistor of not more than 10 ampere capacity will be required. If desired, another current transformer may be used to measure the current in the thermal element circuit instead of putting the ammeter in the position shown. This is more accurate but you can check a setup with both ammeters and see how they compare. If results are fairly accurate with the ammeter in the position shown, then you will find this arrangement more preferable.

Care must be exercised to let the thermal elements come up to normal operating temperature before drawing any final conclusions regarding their condition. With proper interpretation of results, the action of the elements can be checked rather closely with actual operating conditions.—C. B. T.

**ANSWER** to J. G.—At Boulder Dam the whole system is multi-breakers and magnetic switches. We test these all out once a year. Here is our procedure.

We take a small soldering transformer 8 volt secondary good for 300 amps, 100 volt primary. We use a variac to adjust the primary voltage, which in turn regulates the amps output on the secondary side. All you need is an amp meter to tell what



current you are pulling across the thermal strip.

We have found this to be exceedingly simple and very effective.—J. P.

**ANSWER** to J. G.—There is no particular way to check the thermal relays in magnetic switches by keeping them inside their respective containers, for their current rating.

In my experience, I have used the following method, by which to check the thermal element rating. I use an ammeter (clamp type for a-c) place it over the wire, run the motor and check the ampere readings when motor is at full load, and be prepared to add additional load to pass through the particular lead until the thermal trips. The constant watching of the ammeter will tell you if the element has tripped. (The ammeter will read zero, when tripped). All this is done within the normal room temperature.

When the tripping of the element happens, you notice the ampere, which is in excess of the motor rating, then replace this element with one tested to suit the motor rating. This is a long process, but a sure way to get results.—O. C.

**ANSWER** to J. G.—A transformer having a 5 or 10 volt secondary such as a spot welding transformer plus an ammeter and rheostat, can be connected in series with the thermal elements instead of the normal load. A clock or watch can be used to see how long the time lag is under certain current conditions. I still like fusetrans that are rated 15% above the thermal element rating, plus a good lock on some jobs to protect my reputation, because a shunt around the thermal element can be easily removed, and attached.—H. S.



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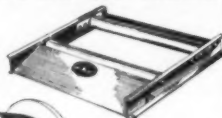
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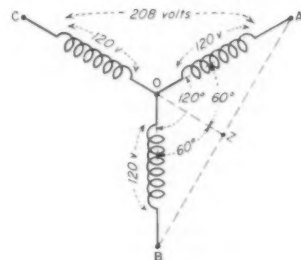
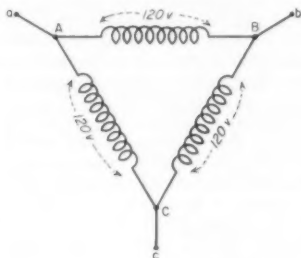
## WYE Connected System

**QUESTION**—A fellow worker and I had a discussion one day about the voltage developed in a Y-connected transformer or generator. He maintained that if one leg to ground showed 110 volt, the voltage between two legs would be 220 volt, I told him I didn't think that they would double like that due to the fact that the two voltages would be 120° E apart and the various voltages would be something like 120 volt to ground and 208 volt between phases. Who is right and why? Does this same rule apply for delta connected transformers and generators?—H. V. S.

**ANSWER** to H. V. S.—In a balanced three phase system, if a Y connected transformer or generator has 110 volts from one leg to neutral or ground, then the leg to leg voltage is  $1.73 \times 110 = 190.4$  volts. Similarly, if 120 volts exists from leg to ground, leg to leg voltage would be  $1.73 \times 120 = 208$  volts. This latter 120/208 volt Y system is common.

The reason why we have the above voltages is apparent if we bear in mind that a-c voltages out of phase cannot be added directly, but must be calculated vectorially. A slight review of trigonometry and the following diagram will show how 120 volts can exist from leg to ground and 208 volts from leg to leg.

The diagram shows that there is 120° phase difference between voltages OA and OB. We wish to find the leg to leg voltage AB. The most simple way to show that voltage AB = 1.73 x



OA would be to find half of AB trigonometrically and then double it.

Half of AB = AZ  
 $AZ = OA \times \sin 60^\circ$   
 $= OA \times 0.866$   
Since  $2 \times AZ = AB$ ,  
then  $2 \times AZ =$

$$2 \times OA \times 0.866 = AB$$

$$2 \times 0.866 \times OA = AB$$

$$1.732 \times 120 = AB$$

by substitution  $1.732 \times 120 = 208$   
or  $AZ + ZB = AB$

$$AZ = ZB$$

$$AZ \times 2 = AB$$

This same rule does not apply to voltages in delta connected systems. In a delta system, the same voltage would exist across any two of the lines as across two others, providing the system is balanced. Thus voltage AB = voltage BC = CA.

However, the above rule does apply to current in a delta system. Current B is the vector sum of currents AB and CB i.e., current in line B would equal 1.732 times the current in transformer winding AB or BC, provided the system is balanced.—R. L. V.

**ANSWER** to H. V. S.—You are correct. In a Y connected system, either from generators or transformers, the ratio of the phase to neutral and phase to phase voltages is 1 : 1.73. This is due to the voltages being 120° E degrees apart. The phase to neutral voltage multiplied by the tangent of the angle between the voltages gives the phase to phase voltage.

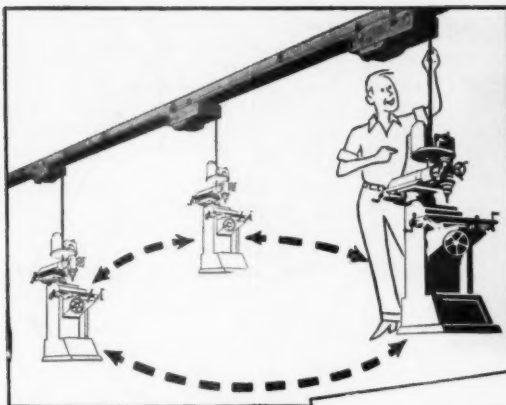
The tan. of an angle of 120 degrees is 1.7321. Multiplying 110 by 1.73 gives approximately 191 volts. With a bank of three 120 v. transformers connected Y, the phase or line voltage is  $120 \times 1.73$  equals 208 v.

In a delta connected system there is no neutral, each unit generates full line voltage.

Sometimes a ground is made either by grounding one phase or connecting the middle point of one transformer to ground. This is only a ground, not a neutral. There is little advantage in either connection. In the first case one wire is the same voltage as ground. The other two are line voltage above ground. In the second case, two phases have half voltage to ground and the third phase has 86.6% of line voltage to ground.

You speak of "voltage to ground". You really mean voltage to neutral. Voltage to ground would only be correct in a grounded system; some systems are not grounded, in which case you would get any voltage between line and zero.—A. E. T.

**ANSWER** to H. V. S.—As a general rule, the voltage diagram of a wye connected transformer bank or gener-



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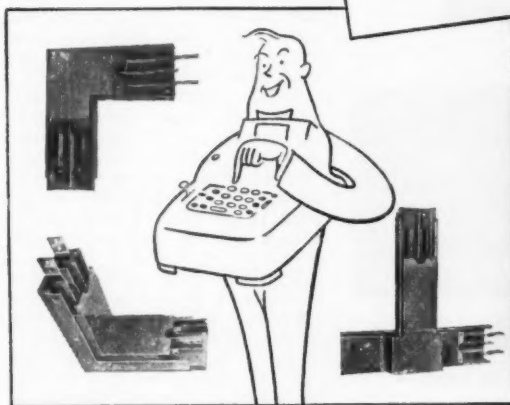
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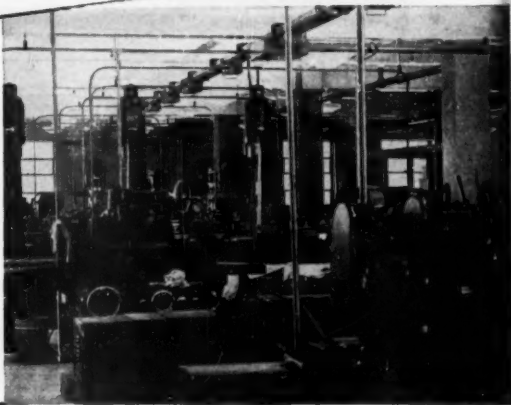
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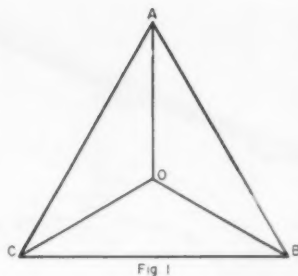


Fig 1

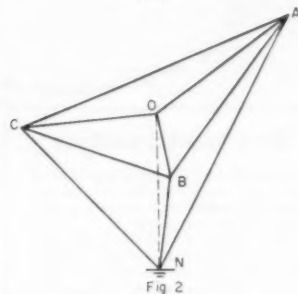


Fig 2

ator is represented as in Fig. 1. Here, the line voltages, AB, BC and CA are 173% of the phase voltages, OA, OB and OC. This is the ideal condition and is often close enough in practical applications. However, there are important exceptions.

In a wye-wye connected transformer, with isolated primary neutral, the voltages become distorted under unbalanced loading conditions. The line voltage diagram may cease to be an equilateral triangle. The neutral point, O, may take any position in the triangle and may even move outside of it.

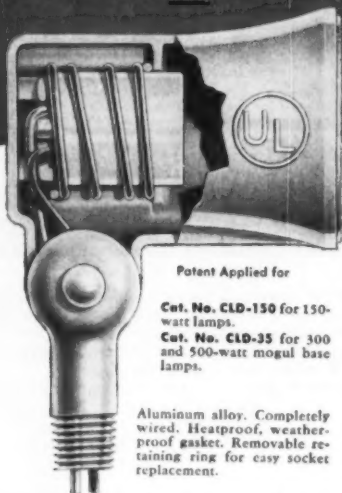
If suitable steps are not taken to neutralize the third harmonic flux in a wye-wye connected bank, connecting the secondary neutral to ground introduces an additional phenomena. Instead of a plane, as in Fig. 1, the voltage diagram becomes a pyramid, as in Fig. 2. AB, BC and CA are the line voltages as before. The phase voltages are NA, NB and NC. The distance NO is the third harmonic voltage, and is influenced by line to ground capacitance as well as excitation.

The neutral shift of the wye-wye transformer connection, both in plane and in space, has made this connection unpopular. Stability is improved by interconnecting generator neutral and transformer primary neutral, use of auxiliary transformers, or introducing a delta winding in the circuit, etc.

The phase voltage is equal to the line voltage in a delta connected transformer or generator. But, under balanced load conditions, the line current

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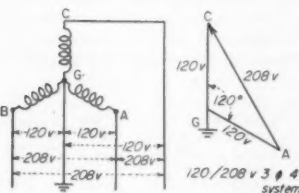
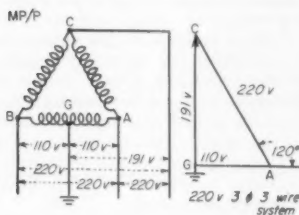


is 173% of the phase current. A third harmonic voltage exists which causes a current to circulate within the delta. This voltage can be measured by taking a reading across any corner of the delta which has been "opened".

—L. E. B.

**ANSWER to H. V. S.**—The sketch shows the grounding points and the voltages between phases and to ground for both the 3-phase, 4-wire, Y-connected, and the 3-phase, 3-wire, delta-connected distribution systems.

For the Y-connected system, although each of the 3 phases reads 120 volts to ground, the voltage between 2 phases would be only 208 volts. This is so because each phase reaches its peak voltage 120° earlier than one other phase, and 120° later than the second other phase. Two phases in series therefore do not have their peaks at the same time, so that



their effective voltage is less than twice the effective voltage of each phase to ground. With a 120° separation, this combined voltage is 208 volt, or the vectorial sum of the two 120 volts 120° apart.

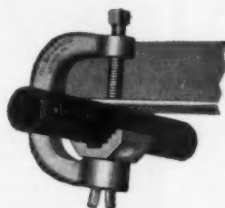
In the 220 volt, 3-phase, 3-wire, delta-connected system voltages between legs are of course 220 volt. The system is grounded with a grounded center tap at one of the transformer windings which, incidentally, is frequently brought in with the service to provide for both 3-phase power at 220 volt, and a 1-phase 110/220 volt lighting load. With 110 volt from each leg to ground in the tapped phase, with 220 volt in each of the other phases, and with 120° of separation between phases, the result is a highest possible effective voltage to ground of about 191 volt, in one leg, and, for the legs in the tapped phase, an effective voltage to ground of 110 volt.—M. P.

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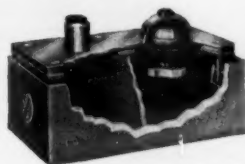
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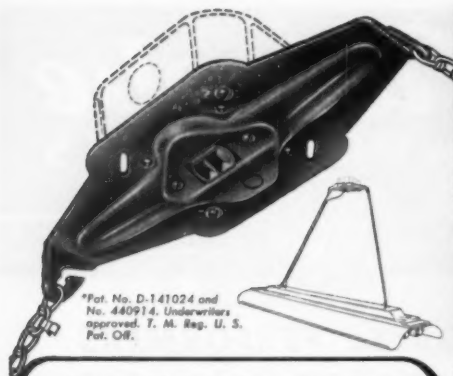
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## Paralleling Transformers

**QUESTION**—Our plant consists of two buildings which have recently been enlarged and connected together.

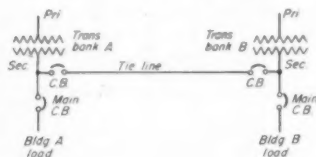
Each building contains its own substation where transformers reduce 13,200 volts to be distributed at 440 volts (wye with grounded neutral). This 440 volt-3 phase—60 cycle power is available at fused panel boxes mounted on steel columns throughout the buildings.

I would appreciate some comments as to whether it would be possible to parallel the load side of a 440 volt panel box in one building with a duplicate panel in the other building, and if so, what the procedure would be.—H.P.H.

**ANSWER** to H.P.H.—The question concerning paralleling load side of panels is best answered by the following means:

It seems obvious that a desire to connect from one system or building to the other is to give a method of maintaining power in both buildings in event of failure of one substation or the other. The approved method of using secondary ties is to make provision to permit tie at point of origin of each supply.

Each secondary in its own building is equipped with a main breaker to protect its feeders. A secondary tie, taken off the transformer secondary ahead of the main breaker is used



to connect across banks. This line is to be protected at both ends by suitable overcurrent protection, and should have the desired capacity required to feed one building in the event of failure of the supply for the other building. This tie should have the same capacity as the main breaker in the largest building for best results.

The tie line may be operated normally closed if desired, giving smoother operation by feeding power either one way or the other to give help where needed. In effect you have a single supply with the capacity of the total of both banks, plus the advantage of being able to operate individually when desired.—E.J.S.

**ANSWER** to H.P.H.—It is entirely possible to parallel the load side of the

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two 440 volt panels. The feeder tying the two panels together should be fused at each end. Care must be exercised that the conductors are connected so that corresponding phases of the two sets of transformers will be connected together. The transformers should be of similar characteristics, with impedances being within 7½% of each other. Also transformer ratios must be the same, with their connections checked to see that they are all set on the same tap. Following the above suggestions, you should end up with a system that is entirely practical and operable.—L.R.B.

ANSWER to H.P.H.—Inasmuch as the two sets of sub-feeders are connected to the same source, there would of course be no change or variation in frequency or rotation between the two feeders as would be the case between two different sources. There would be no need to use a synchroscope or lamps to match them. All that would be necessary is simply to make a voltage test between the two sets of wires and any two which give zero reading would match them up without any other test necessary.—L.S.

### Can you ANSWER these QUESTIONS

**QUESTION C-17**—Being given a box of assorted dry type rectifiers without data as to type of oxide, permissible A.C.V. etc., how would one go about (a) determining type of oxide, (b) permissible A.C.V., and (c) approximate output in amps.

Any other pertinent data and comments will be very much appreciated.  
—E.S.C.

**QUESTION D17**—Can one of your readers explain how a split-phase motor driving a fan could be slowed down and increased in speed according to the temperature rise and drop of the air it is circulating?—E.S.H.

**QUESTION E17**—We have on hand a 440 volt three phase 1800 rpm. 30 cycle wound rotor motor with drum controller and resistance bank. This is a 150 horsepower motor. Is it practical to reconnect this for 60 cycle operation?—W. P. R.

PLEASE SEND IN  
YOUR ANSWER BY SEPT. 15

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# Questions on the Code

## Fuse Location

**Q.** In a rather inaccessible roof space, a tap is to be made from a 15 amp. branch circuit, the tap to be fused at less than 15 amps. It is desired to place the cutout near the scuttle hole where it will be readily accessible.

Is it permissible to have a "fuse loop" like a switch loop or must both the hot and neutral wires be brought down to the cutout box at the scuttle hole?—W.A.B.

**A.** Fuses in general should always be readily accessible and a "rather inaccessible roof space" is certainly not "readily accessible" especially if access to it is through a scuttle hole in the roof. If access is by means of a trap door in the ceiling of a room below, the accessibility is less difficult. Any Inspector would probably object. On the other hand, however, the fuse referred to in the question, is not a branch circuit fuse, but is evidently a fuse to protect some particular piece of equipment at a rating of less than 15 amps.

If the local Inspection Bureau will grant a concession for the fuse to be located in the roofspace in this instance, it would be necessary to run only two wires of the loop down to the fuse within the same metallic armor and it would not be necessary to run the "neutral" down, as no induction would result with only the two wires of the loop.—F.N.M.S.

## Grounding Conductor

**Q.** One of the electrical contractors working in this area insists that when rigid conduit is used for a service, the neutral grounding conductor from the neutral bar in the service cabinet to the ground rod is not required due to the fact that ground is established by means of the surge conductor which extends from the neutral conductor at the service head directly to a ground rod and is bonded to the top of the service raceway so a path is established between the neutral terminal bar and the service equip-

ment via the raceway to the ground electrode. It seems to me there is some provision in the Code which requires that a grounding conductor be run directly, but as I have been unable to find it, I wish you could give me the number of the section in which this requirement will be found.—C.L.A.

**A.** Section 2591 of the N. E. Code states that the grounding conductor of a wiring system shall be of copper or other corrosion-resistant material and that the conductor shall be either solid or stranded, insulated or bare and shall be without joint or splice throughout its length except in the case of a bus bar, which, of course, may have joints. In other words, a piece of conduit cannot be used as the grounding conductor of a wiring installation as would be the case where the ground was made via the raceway as described in your letter. Furthermore, as the Code states that the grounding conductor shall be continuous, with a single exception that where a bus bar is used it may contain joints, there is no question but that the conduit attached to a service equipment would contain one or more joints which would definitely be a violation of the code.—G.R.

## Building Switches Through Master Service

**Q.** At the present time we are planning new service facilities for a canning factory which comprises several separate buildings under single management and occupancy. Our plans include a new and larger transformer installation with a switch house independent of any of the other buildings. A secondary switchboard will be installed in the new switch house and secondary feeders run to each building concerned. We note, however, under N. E. Code Section 2351 d that each building served shall be provided with a readily accessible means of disconnect within or adjacent to the building. Just what does the word adjacent mean? Two of our secondary feeders will run about 70 feet from the switch

house. Two others will run about 25 feet. Does the word adjacent mean that disconnect switches must be installed in each building served in addition to the disconnects already planned in the switch house?—L.C.

**A.** When this new wording of Section 2351 d appeared in the 1947 Code there was considerable speculation as to the meaning of the word "adjacent" and as a result different opinions were given with the result that confusion remained in the minds of many. The matter, however, was clarified to a degree by official interpretation No. 313 issued on December 10, 1948. This interpretation covered the case of a garage and a dwelling located on the same premises. In considering the term "adjacent to the building" the finding advised that the intent was to follow the practice specified in the 1940 Code. This requirement was covered by Section 2306 in the 1940 Code and reference to same shows that the feeder switches may be located in the building served or in another building provided it is accessible to the persons using the installation. In line with this reasoning it is evident that the feeder switches located in the switch house satisfied the intent of the word adjacent as used in Section 2351 d, and it will not be necessary for you to specify additional switches in each building served. Irrespective of this Code requirement, however, consideration should be given the advisability of installing switches in each building served especially where long runs are involved.—B.A.McD.

## Farm Wiring

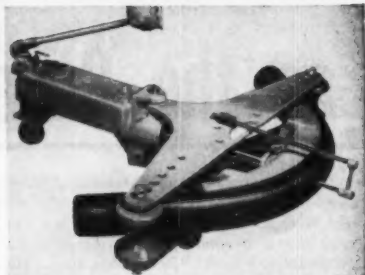
**Q.** I recently began the wiring of farm properties served by R.E.A. lines and in each one of the barns wired, the inspector has furnished a rejection slip stating I neglected to provide a seal in the conduit raceway serving the lighting fixture in the hay mow light. It appears to me that this is some type of an arbitrary ruling as I have never heard of such a requirement before this and so far I have been unable to find any-



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thing in the Code which will substantiate this request. I will therefore appreciate being advised as to whether this is actually a Code requirement or some local regulation.—H.R.

**A.** It so happens this actually is a Code regulation which will be found under Section 3015. However, I believe it is only recently that R.E.A. inspectors have made use of this requirement and that was forced upon them due to the fact a considerable number of farmers were complaining of the formation of moisture within the dust-tight type fixture commonly used for lighting hay mows. This moisture would form because of condensing action within the metal raceway and then in freezing weather would break the glass enclosure about the light bulb. As broken glass in animal food is extremely hazardous, it would necessitate the farmer spending considerable time in a careful search for all particles of broken glass or the waste of a certain amount of hay which might contain such broken glass. When this problem was first brought before a group of inspectors working on R.E.A. projects, Section 3015 of the Code was found to be the answer to this problem. The conduit supplying the hay mow light actually passes through different temperature levels varying from the animal heated section through the hay to outdoor temperatures which exist above the hay. On those projects where this ruling has been enforced during the past several years, no more bad experience has been had with the breakage of these enclosing glass globes over the light bulbs. Many R.E.A. inspectors therefore are now requiring that some type of sealing compound be inserted in the conduit at the point where the conduit enters the light fixture in the hay mow, to prevent this passage of moisture laden air into this fixture.—G.R.

**More Underground Wire**

**Q.** With reference to the—barn wire and in view of the characteristics of this wire being acid resistant and using the neoprene jacket for insulation, please advise if it is acceptable to make a short underground run in sand with No. 12/2 conductor to accommodate a 100 watt yard lamp? —G.M.B.

**A.** If the UL marking for the wire shows that it is listed by them as USE or ASE (for use underground), it will be O.K. to bury it but otherwise not.—F.N.M.S.

## End to End Fixture Assemblies

**Q.** Section 4150 of the Code permits fixtures approved for end to end assembly to be used as a raceway for a single branch circuit. Would the use of a 6 inch or less length of conduit between each fixture be acceptable as meeting the end to end qualification for recognition under this rule?—J.H.

**A.** No. Official interpretation No. 342, issued October 5, 1949, definitely rules out the use of nipples as forming the specified end to end design of fluorescent fixture assemblies. It follows, therefore, that the construction covered by your question would not qualify the fixtures to be used as a raceway.—B.A.McD.

## Parallel Connection

**Q.** We are using a three contact (pole) magnetic switch to control a 10 kw. electric heater. The magnetic switch was designed to carry 28 amps. We have paralleled the points and only disconnect one leg of the feeder from the 60 amp. safety switch to the heater. Is this permissible or should we use a larger magnetic switch and disconnect both feeder wires?—L.E.V.

**A.** While it would seem that a three pole 28 amp. magnetic switch, when connected with all three contacts in parallel, should easily carry a 10 kw. load, it is not good practice to so connect a switch and expect that the load will divide evenly over the three poles.

The Code does not require that a motor controller with a disconnecting switch ahead of it, open all ungrounded conductors but there is no similar rule for heater circuits.—F.N.M.S.

## Demand Factors

**Q.** Do the demand factors shown in Table contained in Section 2203 a. apply to the service conductors and also to the rating of the main service switch in a building housing 24 individual apartments each of which contains three circuits, two rated at 1500 watts and one rated at 1725 watts?—P.M.

**A.** Yes, the demand factors given in Section 2203 a. apply to the service conductors, the service en-

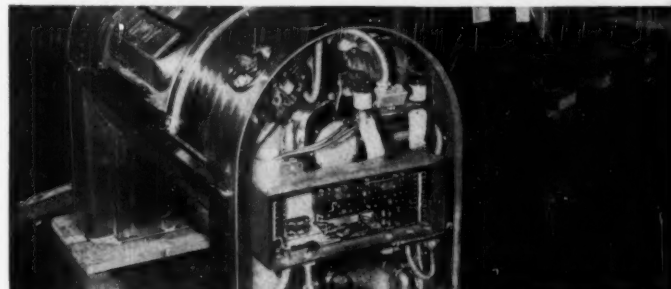


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**ELECTRICAL CONSTRUCTION  
and MAINTENANCE**

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trance equipment and also to feeders and subfeeders. If you still have in your possession a copy of the 1940 Code, you will notice that among the examples contained at the back of that code almost a duplicate of this question. Unfortunately due to the extra pages required in the 1947 edition, it was deemed necessary to leave these examples out of this last edition of the code. Therefore, in your particular problem to determine the size of the service conductors necessary, you would simply use 100% of the first 3,000 watts plus 35% of the balance not in excess of 117,000 watts to determine the proper conductor size. With 48 1,500 watt circuits and 24 1,725 watt circuits, there is a total load of 113,400 watts. By applying the above mentioned demand factors, we reduce this to an actual service load of 41,640 watts which with a three wire 115-230 volt service shows a loading of 168 amperes on each ungrounded conductor for which a 2/0 Type RH or a 4/0 Type R or T conductor would be suitable. With this loading a 200 ampere main line switch would be acceptable by the Code authorities.

It is always well when designing a wiring installation for a building such as this to carefully evaluate conditions as they may be at some future time as compliance with the Code regulations does not assure an adequate installation nor does it provide for possible future growth in current usage as it is simply a set of minimum standards to assure greater safety to life and property.—G.R.

**Switch Enclosures  
As Raceways**

**Q.** I recently installed four 100 ampere switches as the main service disconnecting means. The boxes were adjacent and connected with nipples through which the service entrance conductors were run and taps taken off for each switch. The inspector says I must change this installation and install a gutter. Is this correct?—J.D.

**A.** Section 3737 b of the Code definitely prohibits the use of switch enclosures for junction boxes, troughs or raceways for conductors feeding through or tapping off to other switches, unless special designs are employed. Your installation is in violation of this rule. The use of an auxiliary gutter would satisfy the rule and result in a desirable installation. Other methods, however, are also acceptable.—B.A.McD.

## Underground Cables

**Q.** I have the electrical contract for a State aided housing project. There is an article in the Specifications that the Electrical Engineer and myself do not see eye to eye. Namely: Article 7 of the Specifications, reads as follows:

"120/240 V. Secondary Distribution: The Contractor shall install distribution to the various units as shown on Drawing E-1 (Plot Plan). Underground cables shall be of Parkway type as manufactured by the — Company, — Company, — Company or — Company, sizes as shown on Drawings. Furnish and install all fused Type A Safety switches as shown on Drawings."

I contend that Parkway type cable as used in this specification, does not mean full metallic as the Engineer would like me to believe. I contend that any underground cable, carrying the name "Parkway" non-metallic can be used.

I would also like the N.E.C. ruling on direct burial of this type cable. That is, non-metallic.—J.F.B.

**A.** The specifications are not sufficiently definite to require the use of "armored", "interlocking armor", "tamper-proof" or "full-metallic" cable. The specifications should have stated what kind of covering was desired.

The National Electrical Code does not require that cables for burial in the ground, be of the leaded or armored type. For such use the cables must be approved (by Underwriters' Laboratories) for use under ground and so labelled. Such cables are generally known as USE and ASE (for use above ground and under ground).—F.N.M.S.

## Outdoor Lighting

**Q.** I am now figuring the wiring of an outdoor baseball field on which the lighting towers will be constructed of three steel tubes welded together in a tripod fashion. The manufacturers of these structures claim that one or more of the steel tube legs may be used to contain the wiring for the towers. However, as there is some question in my mind concerning the advisability of this, I shall appreciate receiving your suggestions as to whether or not this would be a Code violation.—V.C.

**A.** There is no reason why a manufacturer of such a light-

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Now you can measure a-c power on non-metered loads without cutting conductors or interrupting service! Just clip the long voltage leads to terminals or binding posts, snap the hook around the conductor, and you're ready to read.

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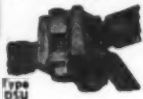


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ing tower could not construct a tubular type leg which would be suitable for the enclosing of the conductors used to supply energy to the lighting fixtures supported on that structure. Under Section 3003 you will note that metal raceways unless made of corrosion resistant material shall be suitably protected against corrosion inside and outside by a coating of approved corrosion-resistant material such as zinc, cadmium, or enamel; except that ferrous raceways, fittings and boxes protected from corrosion solely by enamel may be used only indoors. This, therefore, requires that an outdoor lighting structure use a metal raceway protected against corrosion from materials such as zinc or cadmium and definitely rules out the use of enamel. Furthermore, in the construction of such a lighting tower where the bracing members are welded to the tubes, it is very likely that the inner surface of the tube at the point of the weld will be left quite rough. It would therefore seem reasonable to expect any electrical inspector to refuse to accept the use of a leg of such a lighting tower as an electrical raceway if that leg were protected against corrosion only by paint or enamel or if an inspection of the interior surface indicated roughness or sharp edges which would be detrimental to the insulation used on conductors.—G.R.

## Service Drip Loops

**Q.** The next to the last sentence of Section 2337 of the Code reads as follows:

"To prevent the entrance of moisture, service entrance conductors shall not be connected to the service drop conductors at a point above the level of the service head or the termination of service entrance cable sheaths."

"On the ranch type home of today it is difficult to comply with this Code requirement without resorting to brackets or poles extending above the roof of the home. A local contractor says this rule does not apply when the service drop conductors are continued along the side of the building as open wires on insulators under the eaves and the connection is made to this extension. Your opinion will be appreciated.—G.H.

**A.** This rule definitely covers a connection between the service drop conductors and the service entrance conductors. The definition of service drop covers overhead conductors from the pole to the first point of attachment to the building. It does not cover that part of the service which has been extended along the side of the

building. As a result the rule does not apply. The fact remains, however, that the objective to be obtained remains the same in either case and I believe that the Inspector would be justified in forcing compliance on this point alone. It appears that the question should be clarified by Code action.—B.A.McD.

## Gasoline Dispensing Islands

**Q.** Section 5142 e of the N. E. Code requires that all circuits supplying dispensing pumps used at gasoline service stations be controlled by a switch having a disconnecting pole in each conductor. On a recent job I ran two circuits to a dispensing pump, one for the pump, the other for a sign on the island. Both circuits terminated in a fitting at the base of the gasoline pump. Is it necessary for me under this condition to install a double pole switch on the sign circuit? —D.S.

**A.** In view of the N. E. Code wording, your question might be the source of considerable controversy. The fact remains, however, that the unswitched ground wire in the sign circuit located in the terminal box at the bottom of the pump presents the same hazard that an unswitched ground wire on the gas pump circuit would present. The intent of the Code would be fully satisfied only if a double pole switch was installed in the sign circuit. The possibility of a spark from the ground wire remains whether the circuit feeds a pump or a sign.—B.A.McD.

## Service Conductors

**Q.** Will the Code permit a second set of service conductors to be installed in a dwelling for the sole purpose of energizing an electric hot water heater when the utility supplying energy provides a special rate for water heating?—M.M.H.

**A.** Under Section 2301 c. the Code states that in a single occupancy, where a set of service conductors is already installed for one class of use, one additional set may be installed for a different class of use. Many inspectors are using this portion of Section 2301 as authority for accepting a second service entrance to a dwelling on which the original service entrance is already loaded to its maximum capacity.—G.R.



# NEW



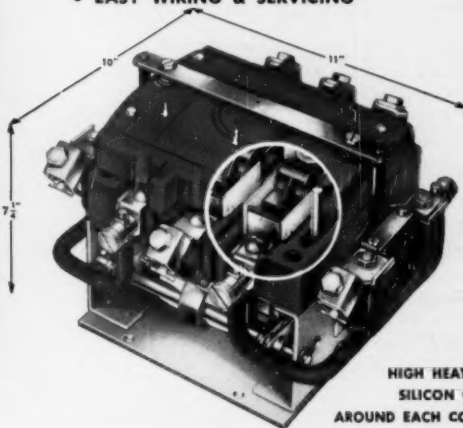
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## TYPE "RA" MAGNETIC STARTER

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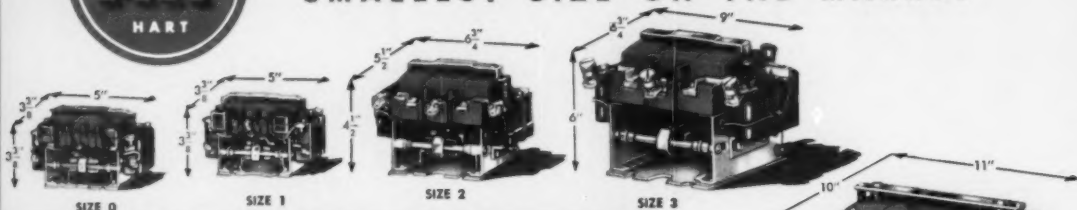


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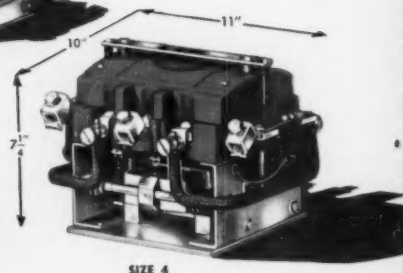
AH starter contacts are made of copper, with non-welding, differential, silver alloy arcing surfaces. Tough, dependable, long-lasting, they are easy to replace. See discussion of arc resistance above.

### LOW WATTAGE MAGNETS

AH starters have magnets designed for economical operation. The high grade, low watt loss material used is specially heat treated to reduce eddy currents to a remarkably low value.

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	POLY-PHASE		1½	2	2	2
SIZE 1	SINGLE PHASE		1½	3	5	5
	POLY-PHASE		3	5	7½	7½
SIZE 2	SINGLE PHASE		3	7½	10	10
	POLY-PHASE		7½	15	25	25
SIZE 3	SINGLE PHASE		7½	15	25	25
	POLY-PHASE		15	30	50	50
SIZE 4	POLY-PHASE		25	50	100	100

### MAGNET COIL WATTAGE CONSUMPTION

		CLOSED GAP, AVERAGE VALUES
SIZE	WATTS	
0 & 1	4½	
2	9	
3	18	
4	35	

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## ELECTRIFYING BROOKLYN BATTERY TUNNEL

[FROM PAGE 45]

formed to 4160 volts for transmission to Governors Island, and to 2400 volts for transmission to an underground exhaust building. In all, 36 feeder and bus tie breakers are in service, equipped with thermal-overload and instantaneous short-circuit tripping mechanisms. Access to boards is from the rear, and liberal-sized wiring troughs facilitate connections. Connections on the boards are by polyvinyl and rubber-insulated 600-volt wiring.

### Telephone Protection

In view of the urgency and importance of telephone calls originating in the tunnel, ventilation building, offices and pumping stations, both automatic and manual telephone systems are provided for intercommunication between all tunnel, plaza, structure and police stations. Both systems are selective signalling and talking.

The automatic system operates at 48-volts dc, supplied by a 100-ampere-hour sealed glass-jar lead-acid storage battery, automatically charged by a full-wave gas-filled tube-type rectifier. Connected to this system are 11 desk, 21 wall, 21 weatherproof and 74 tunnel telephones. Operation is completely automatic, with relay action and mechanical motion causing selectors and connectors to automatically rise and rotate to the proper level and contact corresponding to the digit dials. Emergency calls to the Control Room desk can be made from any station, with tunnel calls indicated by red pilot lights, outside calls marked by green pilots, and calls being "held" indicated in white.

Connecting toll booths directly with the toll sergeant are cordless turret-type switchboards with 2-way lever keys, visual pilot lights and audible buzzers. To insure privacy between an individual booth and the toll sergeant, intercommunication between the 12 booths is impossible and only one call can be handled at any time.

### Construction Power

Working at times 125 feet below water level and under air pressures up to 37 psi, two contractors simultaneously drove twin 31-foot diameter tunnels (45 feet c-to-c) from opposite sides of the river towards the midpoint. Boring through rock, hardpan, clay and silt, sandhogs removed over 758,000 cu. yds. of excavation, installed over 93,000 tons of cast iron

lining rings, and poured 94,000 cu. yds. of concrete.

To insure uninterrupted current for air compression, lighting, discharge pumps and mucking equipment used during construction, multiple sources of utility power were employed. On the combined jobs, six 13.8-kv networks were tapped, with transformers stepping current to 2300-volts for compressor motors; to 440-volts for operating tunnel-located muckers, hoists and pumps, and to 110-volts for tunnel lighting.

Eight compressors, with a total capacity of 45,500-cfm at 50 psi, were driven by 600, 625 and 800-hp. motors. In addition, four 2-stage compressors with combined capacities of 5400-cfm at 125-psi and 4060 cfm at 135 psi were driven by 450 and 500-hp. motors for operating high-pressure construction equipment. Control was both manual and automatic, with switches mechanically interlocked to prevent improper sequencing. In addition to counteracting surrounding water pressure, compressed air was used for shield jacks, rock drills, drill sharpeners, grinders and elevators.

Lighting during construction consisted of 50-watt lamps strung on temporary circuits and spaced 16 feet apart. Wiring was supported from dowels driven into holes drilled in the rock walls.

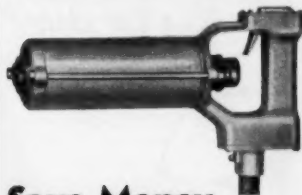
### Safety Measures

As a safety measure, lights were disconnected for a distance of 100 feet from the heading each time blasting holes were charged, and illumination was provided during the charging periods by insulated floodlight lanterns set far back from the holes. By disconnecting lights, premature explosions due to electrical contact from faulty insulation were prevented.

Also for safety, dual communication systems were installed; regular outside telephone circuits running down the shafts and up to the headings, and battery-operated crank-operated ringing systems between headings and field offices.

Ralph Smillie, chief engineer; and Leo Geenens, electrical engineer were in charge of electrical work for the Triborough Bridge and Tunnel Authority. Electrical contractors responsible for wiring, control, switchgear, communications, lighting and ventilation included Fischbach & Moore, Inc.; Hoffman & Elias, Inc.; Goodrich Electrical Installation Co., Inc.; Jandous Electrical Construction Co., (all of New York City), and L. I. Waldman & Co., Brooklyn, N. Y.

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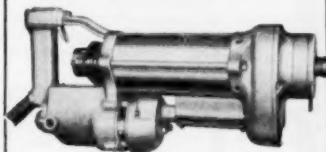


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widely varying conditions. It can be supplied with a number of control features such as an omitting device, advanced time cut-off, or an astronomic dial for automatic sunset to sunrise operation. All these features are available on the Type W which, in addition, is provided with a complete electrically-wound mainspring and timing mechanism that takes over immediately in case of a power failure and does not have to be reset after current interruptions. The Types L, W, and all other high quality switches of the complete Sangamo line are stocked by your electrical wholesaler.

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# SANGAMO

ELECTRIC COMPANY  
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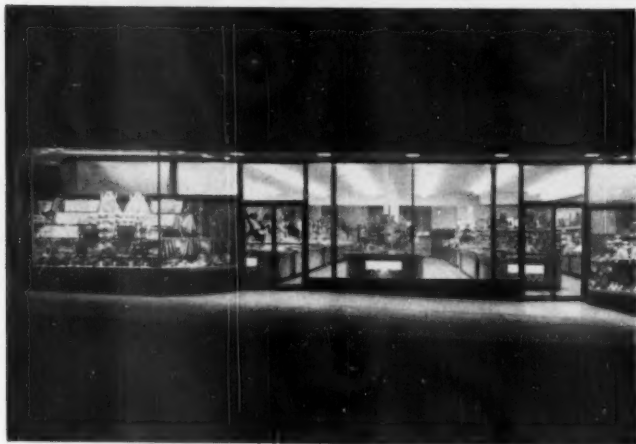
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5112P-12

# Modern Lighting



**HIGH INTENSITY** lighting in show windows and interior of new Rose's 5-10-25c Store, Greenville, S. C., attracts customers and increases sales.



**INTERIOR** lighting system consists of six continuous rows of 4-lamp slimlines in Garcey luminaires, supplemented with incandescent spots, and provides over 90 footcandles intensity.

## Good Lighting Aids Sales

For more than 25 years officials of Rose's 5-10-25c Store Co., chain store operating throughout North and South Carolina, have recognized that high intensity, high quality lighting attracts customers and creates sales. Experience has shown that it expedites the selection of merchandise, and enables the sales clerks to make more and easier sales. For these reasons, the lighting of this chain's stores which

have been opened up over the past several years partially reflects the progress in lighting techniques and lighting equipment.

One of the recently opened stores in the Rose chain is in Greenville, S. C. Equipped with continuous row 4-lamp slimline fluorescent luminaires, containing incandescent accent lights between luminaires and at the ends of continuous rows, the lighting in this

new store represents the current modern lighting technique for this type of area. With the continuous rows spaced on ten-foot centers, an average intensity of over 90 footcandles is obtained throughout the sales area.

The store interior is 58 feet wide and 87 feet long. Six continuous rows of Garcey No. 2496HL 4-lamp slimline luminaires are used. Garcey double pivot incandescent accent lights are placed in between each eight-foot long luminaire, and at each end of each continuous row. The ceiling is white, and the side walls are pale green of high reflectance.

The show windows are lighted to an intensity of over 150 footcandles with Garcey 200-watt incandescent flush recessed reflectors.

## Plexiglas Ceiling For Generating Station

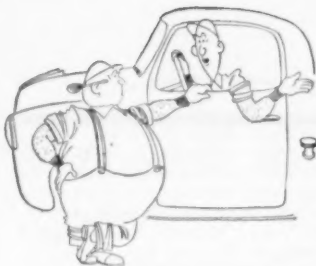
An all-luminous ceiling, consisting of 3-foot squares of 4-inch thick Plexiglas sheets, grit-sanded on the lower side to produce a diffusing surface, and polished on the upper sides to promote interflexion, covers the entire area of the control room located in the Philadelphia Electric Company's Barbadoes Island Generating Station at Norristown, Pennsylvania. It has resulted in the total elimination of shadows on instruments and working areas.

These luminous sheets, suspended in a T-iron framework 11 feet above the floor, are treated on both sides with anti-static wax which has reduced the accumulation of dust to a minimum and has proven a definite maintenance aid. Above the ceiling, an air space varying up to 6-feet in height is painted a flat white with two coats of titanium-oxide paint having a reflectance factor of 75 percent. All air-conditioning equipment in this enclosed space is similarly painted.

Panels were first installed with the diffuse side up, and this position was maintained for two months—during which time the Plexiglas sheets obtained a slight initial deflection. The panels were then reversed and, 3 months later, all traces of this initial deflection has disappeared and have not developed in the opposite direction since that initial period.

Lighting is cold cathode, there being



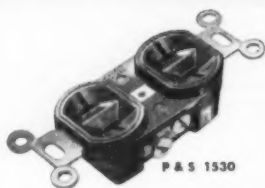


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*P. S. The boys must be using P & S devices. No matter how you use your extra time, P & S wiring devices take less time to install. You spend less time on the job—you have less trouble with customer complaints—when you use P & S devices. All this adds up to more profit, more prestige—and more paid-for time for yourself.*



**This T-slot duplex outlet is a time saver for you**

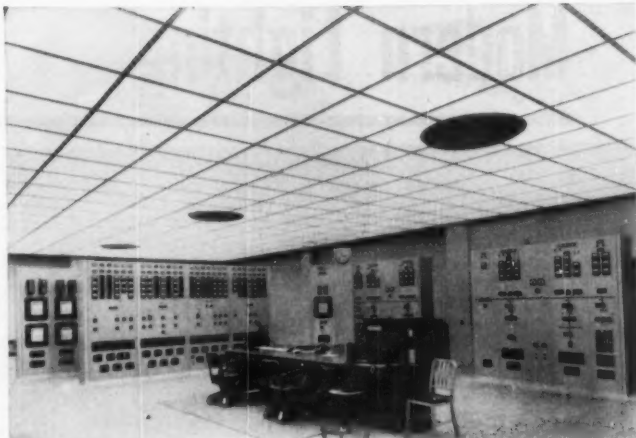


This easy-to-install T-slot duplex outlet has a completely insulated back . . . a sturdy, compact, all-bakelite body, cut away at the ends to allow more room in the box for cable clamps, locknuts, bushings. Large No. 8 binding screws are spaced far apart, take No. 10 wire easily . . . shipped with one screw on each side backed out to speed installation . . . plate screw hole topped in strap—no rivet to twist or turn . . . washer type plaster ears . . . phosphor bronze contacts designed to grip cap blades securely, built to last. Rated 15 amps, 125 volts; 10 amps, 250 volts; meets or exceeds all Federal and REA specifications, carries Underwriters' approval. Order today: P & S 1530 (brown), P & S 1530-I (ivory). P & S wiring devices are available only through recognized electrical distributors.

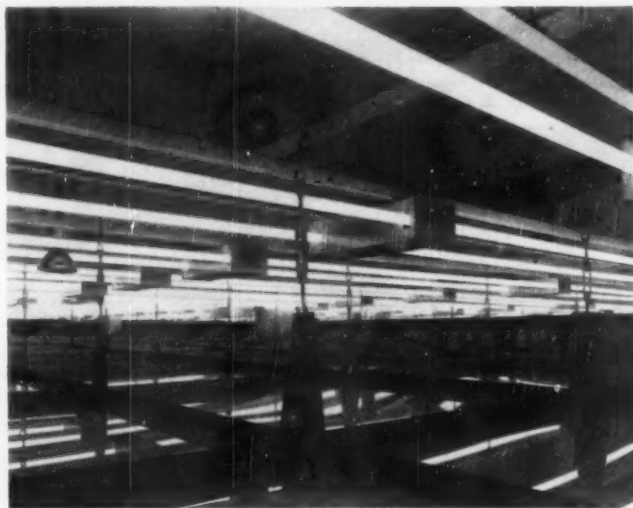
**PASS & SEYMOUR, Inc.**



**34 Boyd Ave. Syracuse 9, N. Y.**  
Maker of the famous P&S-Despard Line



**PLEXIGLAS CEILING** covers entire 72- by 39-foot area of Philadelphia Electric's Barbadoes Island Generating Station control room. Shadows are eliminated on both working areas and instrument faces.



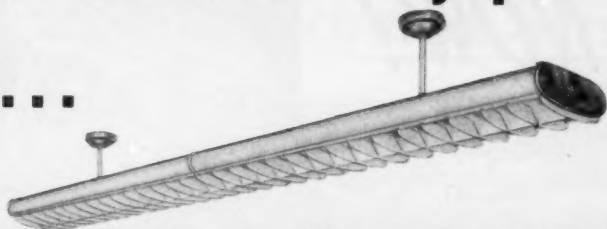
**COLD CATHODE LAMPS** are mounted 17 inches above luminous panels which are suspended by T-iron framework. Anti-static wax on panels is proving a definite maintenance aid.

a total of 19 lamps (93 inches, 25 mm) operating at 100 ma. with Salneu right-angle terminals. Lamps are mounted in pairs 17 inches above the panels and 14 inches apart. Center lines of pairs are 3 feet apart. In the installation, a total of 9600 watts were connected (346,000 lumens), producing average horizontal intensities of 36 footcandles and vertical readings of 15 ft.-c. Emergency lighting is by means of 150-watt PAR-38 incandescent lamps suspended above the luminous panels and operated by storage battery when the ac falls below cold-cathode operating minimums.

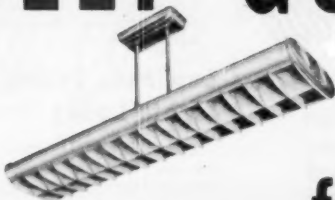
Side walls of the generating station control room are light buff, switchboards (with non-reflective instrument glass) are light aluminum, flooring is light grey asphalt tile, and furniture is green-topped grey.

Beneath this all-luminous ceiling, shadows on all working surfaces are completely absent, permitting operating personnel to read meters rapidly and accurately, and to carry out desk work with minimum eye fatigue. Maintenance and relamping facilities have been provided so that time required for these services are drastically reduced.

Every Sylvania Fixture...every part  
...every lamp...



FULLY GUARANTEED



for ONE YEAR



*This complete guarantee is a mighty selling aid! It builds customer confidence in you, the Electrical Contractor.*

Remember—Sylvania offers your customers the only complete and binding guarantee in the fluorescent fixture field.

This guarantee covers lamps, starters, ballasts, lamp-holders and "any other component part, for a period of one year"... with

the purchase of 25 or more Sylvania Fluorescent Fixtures.

It means that Sylvania backs you up to the hilt... protects your profits and takes a big load of responsibility from your shoulders.

The attached coupon brings you full details about the full line of Sylvania fixtures. Don't delay, mail it today!

**There's profit in  
"Preventive Maintenance" too**

Be sure to follow up every electrical installation with a "Preventive Maintenance" contract. You'll find it good business that makes good customers... for keeps. Says the NECA Manual: "Preventive Maintenance is the modern industrial application of the old axiom, 'An ounce of prevention is worth a pound of cure.'"

FLUORESCENT LAMPS,  
FIXTURES, SIGN TUBING,  
WIRING DEVICES, LIGHT  
BULBS, RADIO TUBES,  
TELEVISION PICTURE  
TUBES, ELECTRONIC  
PRODUCTS, ELECTRONIC  
TEST EQUIPMENT, PHOTO-  
LAMPS, TELEVISION SETS

**SYLVANIA  
ELECTRIC**

Sylvania Electric Products Inc.  
Department L-2008  
1740 Broadway, New York 19, N. Y.

Please send me illustrated folder showing the complete line of Sylvania Fluorescent Fixtures.

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City  Zone  State

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McGILL  
*Levolier*<sup>®</sup>  
NO. 41



## GUARANTEED

## Unconditionally

*\*Levolier Model 41 6 amp. "T" rated 125 volt switch is unconditionally guaranteed when used in lighting circuits. In case of failures a new Model 41 switch will be furnished without charge.*

When you install Levolver Model 41 switches in lighting circuits, you've installed the switch that will not fail. No kick-backs. No complaints. Just dependable, always-working performance. In fact, the patented Levolver action is so positive that the No. 41 is unconditionally guaranteed\* NOT TO FAIL. Thousands of Model 41's, in use for years, prove this true.

The small, compact size of the Model 41 makes it ideal for use in modern lighting fixtures and canopies, as well as for FHP motor control.



A new addition to the Levolver line is the Model 71. This 6 amp. 125 volt, "T" rated switch is encased in a molded plastic case less than 1/2" thick. Pressure connected six inch wire leads provide fast, easy installation.

AVAILABLE FROM YOUR ELECTRICAL WHOLESALER



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McGILL  
TRADE MARK

electrical  
specialties

ONLY McGILL MAKES *Levolier* SWITCHES



**LUMINOUS CEILING** formed from Plexiglas plastic panels in decorative pattern provides dramatic lighting for inner lobby of Philadelphia's new Randolph Theatre.

### Luminous Ceiling Lights Lobby

A low brightness luminous ceiling was used to light the inner lobby of the new Randolph Theatre in Philadelphia. The luminous area, forming practically the entire ceiling, consists of flat and corrugated panels of translucent Plexiglas acrylic plastic supported on narrow metal supports, and transmits light from a series of cold cathode tubes installed above.

The main section of the ceiling is composed of squares and triangles of corrugated white plastic, Plexiglas, Type C-1, color No. 122-125, 30" x 30" x .125" thick. The triangles are half-sections from the 30-inch squares. Corrugations of adjoining panels run at right angles which adds an interesting design pattern. Flanking the main section on all four sides is a decorative border which consists of flat white sections of .187" thick Plexiglas, color No. 122-75, to which is cemented a pattern design of green Plexiglas.

The entire luminous ceiling area is 13 feet by 20 feet. It is lighted from above with twelve 20-foot rows of 3500-degree cold cathode tubes, mounted 18 inches above the plastic panels on twelve-inch centers. The "wall-to-wall fixture" is suspended from the ceiling above, which is painted flat white, with simple guy wires and turnbuckles that hold in place the enameled metal supports on which the Plexiglas panels rest. The light weight shatter-resistant, acrylic sections are easily lifted out for access to lamps and wiring for maintenance.

The Plexiglas panels were furnished by Rohm and Haas and the installation was designed, produced and erected by Voigt Lighting Fixture Company, both of Philadelphia, Pa.

# ONLY module LIGHTING CUSTOM-FITS

*this MAGIC  
low-cost way*

THESE 4 MODULES ARE THE  
"BUILDING BLOCKS" OF LIGHT



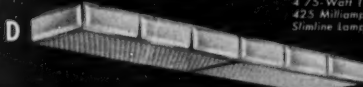
A 14-Watt T-12  
15" Type F Lamp



B 32-Watt 12" Curline  
Lamp, and 1 PAR Spot  
or Flood Lamp

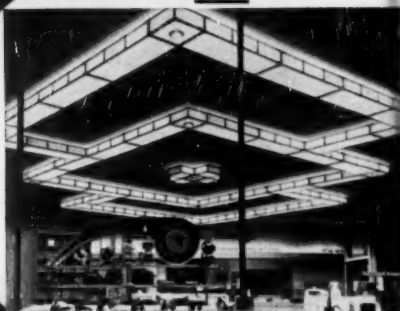
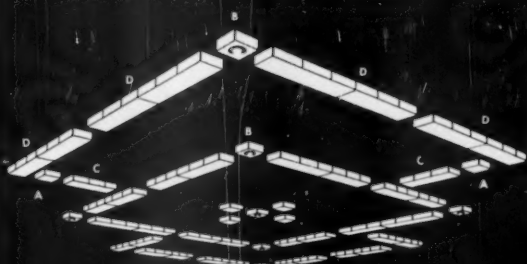


C 40-Watt T-12  
48" Type F Lamp



D 75-Watt T-12  
425 Milliamp  
Staircase Lamp

THEY FIT TOGETHER LIKE THIS... FOR LIGHTING MAGIC LIKE THIS



**50,000 different patterns possible—20% more light!**

Nothing in lighting compares with MODULE! Nothing in lighting matches MODULE's custom-fitting flexibility and economical high-efficiency.

It's amazing! With just 4 simple, low cost "building blocks of light," MITCHELL MODULE offers unlimited custom-fitting lighting patterns to fit any commercial interior. MODULE's exclusive plastic louver passes 20% MORE LIGHT. Simple fitting together of units (mechanically and electrically) permits low cost rearrangement of patterns at any time to suit changing needs. MODULE mixes all light sources smoothly in one harmonious, handsome system—puts the light exactly where it's needed. No ordinary fixtures can match MODULE—the only lighting that custom-fits with standard low-cost units.

## Only MITCHELL makes MODULE

There's nothing in lighting like MODULE. It custom-fits and "grows" with every lighting need; it delivers more light; it stays beautiful, new; it costs no more than ordinary fixtures. If you haven't all the MODULE facts, write today for full descriptive details.

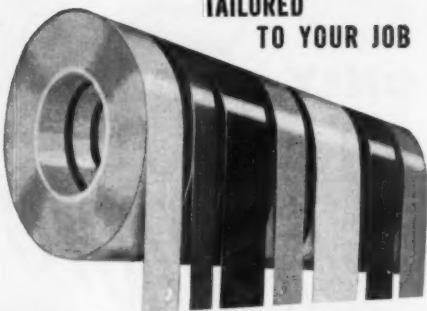
## MITCHELL MANUFACTURING COMPANY

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**YOU SELL module INSTALLATIONS WHEN YOU TELL THIS SELLING STORY**

THE NEW  
**Polyken®**  
INDUSTRIAL TAPES

TAILORED  
TO YOUR JOB



**No More Bulky Splices**

This is one of many applications where the new *Polyken* No. 163 does a better job than old-fashioned friction tape. Less bulky and doesn't have to be wrapped around *itself* to stick. Has a high adhesive tack that sticks quickly and firmly to any clean, dry surface.

**After 70 years—an electrical tape  
that costs less than friction tape**

This is the first new thing that's happened in the friction tape field in nearly a century—*Polyken* No. 163. An electrical tape that sticks to any surface as well as to itself. It has higher dielectric strength with less bulk. Forms a better moisture

barrier. Doesn't fray. Sticks better and is easier and cleaner to handle.

All this, new *Polyken* No. 163 brings you . . . yet costs less than old-fashioned friction tape! See your *Polyken* distributor today.



**FREE BOOKLET**

To learn more about revolutionary new tape, *Polyken* No. 163, write for free folder, "Test It Yourself!" Address *Polyken*, Dept. EC-1, 222 W. Adams St., Chicago 6, Ill. Or call your distributor.

*Polyken* Industrial Tape, Department of Bauer & Black, Division of The Kendall Company



# In the News

## Construction Outlook Shifts To Military—Industrial Needs

**Sharp upturn ahead in industrial, utility, military electrical construction requirements. Housing, commercial, institutional may level, eventually decline, if materials run short.**

What's going to happen to the construction boom which has pushed electrical work to high volume levels this year? Washington won't know for a while. But the facts are that what was a \$13 billion military program is now \$23 billion, and only the beginning.

An already near full national economy will have to absorb an accelerated defense program and arm a large portion of the world. And it is virtually certain that further appropriations will be called for while demands of the military for manpower will cut into the 61 million work force.

The effect of the President's message to Congress goes far beyond the scope of his requests. Inflation is building up rapidly as business and consumers alike rush for a better inventory position. The first effects on the electrical industry will be a rush of jobs which have been waiting decision to proceed. The next wave will come in industrial rewiring and electrical modernization work that will get under way anticipating conversion requirements.

The sudden shift in business attitude toward supplies and inventory has created apparent scarcity and some hysterical ordering. Contractors with long term contract commitments on narrow margins are especially vulnerable. Their attempts to cover material needs all at once in the prospect of almost inevitable price rises and eventual shortages is likely to be mistaken for hoarding. The period ahead is going to require a good deal of co-operation, understanding and restraint all along the lines of distribution.

Suppliers are already "editing" orders in an effort to sort out immediate needs and space delivery dates against actual requirements. Some of the problem is "scare" buying anticipating an immediate drying up of material supplies. The facts are, however, that manufacturing and distribution of electrical materials is moving at an unprecedented pace. With the fastest possible reconversion of industry to war production, the flow of electrical materials is unlikely to be

noticeably diminished for many months.

It should be noted that the present additional appropriation of \$10 billion is thrown into an economy running at the rate of \$250 billion gross national product. A sudden freezing of the going civilian economy to take up such a relatively small additional burden is not likely.

Industry is actually anticipating a greater load than the initial appropriation request indicates. But even so, there is talk of 5 million cars and trucks, 750,000 new homes. These represent a drastic cutback from present rates, about 40 percent, but hardly a "bare-bones" civilian economy.

Controls are a different matter. Allocations and price controls are inevitable and maybe closer than we think. But controls do not diminish supply.

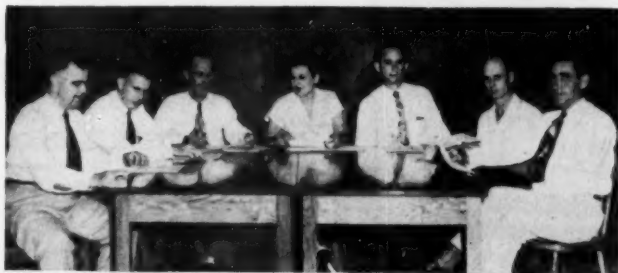
No one is yet willing to guess when manpower controls will come in. Some labor contracts under negotiation during the past month called for wage increases substantially beyond the normal pattern. Wage and price ceilings, consumer rationing and higher taxes, according to the politically minded, won't come until after the elections.

Construction materials control will

probably head up in Commerce, electric power and fuels in Interior. Allocations will start with steel, tin, copper and aluminum.

Three stages of development are predicted by observers. First, there will be a let's-get-going rush to get into production on first essentials; aircraft, military supplies, without controls if possible. Next, a beefing-up of agencies to carry out plans on a longer scale, then a full scale military and defense program with strong controls, some used, some held in abeyance but ready for prompt use.

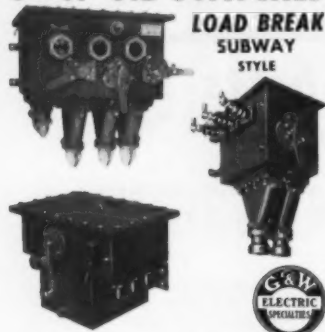
Industry will be strongly advised to get electrical facilities in first class shape with reasonable flexibility to meet probable requirements. Long term commitments by contractors on big projects, that may be far down the priority scale, should be approached with caution. What can and will be done to bail out contractors involved in projects which may have to be halted by directive or by drying up material and manpower has not been considered. It should be noted, however, that electrical work has held an essential status in war economy and serious limitations may be well into the future.



**JOINT MANAGEMENT-LABOR** Apprenticeship Committee in the electrical trade in Meridian, Miss., is headed by Mrs. Beatrice D. Pace, owner and manager of Pace Electrical Company. Other members of the committee shown from left to right are Waldo Bounds, Electrical Engineer, Mississippi Power Co.; Lewis Beasley, Jr., Bureau of Apprenticeship U. S. Department of Labor; Woodrow C. Bryan, committee secretary, business manager, Local 917, IBEW; Mrs. Pace; David Owen, owner and manager, David Owen Elec. Co.; David James, Journeyman, Local 917, IBEW; R. E. Davis, Business Manager, Local 1209, IBEW (Miss. Power Co.).

Sectionalize with

## G & W OIL SWITCHES



For safe, speedy sectionalization of cable circuits install load break subway oil switches. If cable trouble occurs, sections can be isolated quickly and circuits re-routed to restore service in the area affected. Load break disconnection is accomplished by manual (or automatic) operation of an external lever. G & W Type "RA" multiple circuit oil switches are solving many sectionalizing problems. Their simple, sturdy design requires minimum maintenance. They save space and provide system flexibility in a simple, economical manner.

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Representatives in principal cities

**NAME YOUR TAPE...**  
GET MORE FOR YOUR MONEY



The tape with the yellow core  
made by **OKONITE**  
SOLD ONLY THROUGH  
RECOGNIZED WHOLESALERS

Ask for them by name...

**Panther and Dragon**  
friction and rubber tapes

## N. Y. State Contractors Meet In Saranac Inn

"Business Promotion Through Salesmanship" was the theme of the 51st annual convention of the New York State Association of Electrical Contractors and Dealers, Inc., held at Saranac Inn, N. Y., July 1 to 8. Registration totalled more than 300 electrical contractors, wholesalers, manufacturers, utility men and inspectors.

A. Lincoln Bush, chairman of the board of the association opened the convention and presided at the Tuesday morning session. A. A. A. Tuna, president, welcomed the delegates to the convention and reported that the membership had doubled during the past year and the drive for more members would be continued.

"The Electrical Inspector Promotes Safe and Sound Wiring" was discussed by J. D. Lynett, Supt., Bureau of Electricity, New York Board of Fire Underwriters. He said that the contractors are underselling themselves by not selling safe and sound wiring.

W. D. Howell, assistant secretary and treasurer of the National Electrical Benefit Fund, Washington, D. C., reported on the status of the fund.

Herman L. Weisman, counsel, Joint Industry Board of the Electrical Industry, New York gave a very straight forward talk on the importance of making a profit. Do not bid below cost, he said, for you cannot count on extras. Stop the bad competitive practices and do not work so hard at trying to prevent the other guy from making money. There isn't enough margin of profit in your business year in and year out. Be good hard competitors but not destructive competitors, he urged.

A demonstration of "Planned Power Distribution" was presented by J. L. Wagoner, assistant to manager, agency

and specialties sales department, Westinghouse Electric Corp., East Pittsburgh. He showed a wiring system in a factory that had not been engineered to keep pace with the load that had been added and how tools, machines, etc., were operating at reduced efficiency. Mr. Wagoner then demonstrated how additional copper, wire and equipment could be added to that factory in order to correct this situation and gain the maximum in efficiency.

Wednesday was Utilities Day and E. A. Brand, district commercial manager, Niagara Mohawk Power Corp., Buffalo, was the chairman. Walter H. McKie, manager, domestic sales dept., Rochester Gas & Electric Corp., spoke on the "Homemaker's Work Shop". He discussed the present day kitchen and the importance of planning it to suit the needs of the customer. He stressed the need for kitchen modernization and pointed out the tremendous opportunities for electrical contractors in this field. Mr. McKie illustrated his talk with slides showing installations of various types of kitchen ventilators.

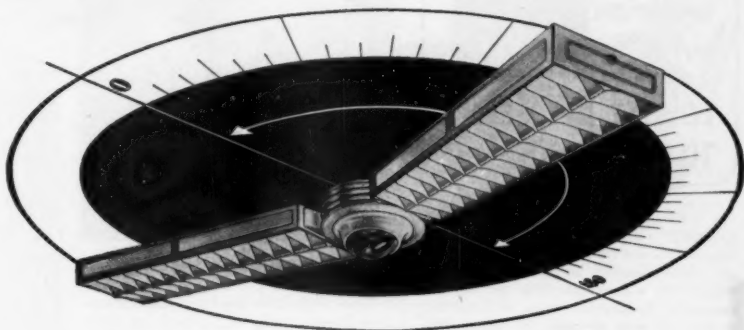
C. D. Hollister, lighting advisor, Niagara Mohawk Power Corp., Albany, discussed the recent NEMA lighting market survey in Indianapolis. He said that they had found that 85% of all lighting in Indianapolis was inadequate. Much incandescent is still being used. They found 40% of all stores, 64% in offices, 65% in small manufacturing plants, and 82% in schools are still using incandescent. When queried as to whom they consulted regarding lighting 10% said they asked friends, 38% electrical contractors, 3% architects, 4% lighting  
(Continued on page 134)



**NASSAU-SUFFOLK** group at the convention of the N. Y. State Electrical Contractors & Dealers, Inc. at Saranac Inn. Seated from left to right—Walter E. Galdi, A. Galdi & Sons; Edgar V. Gray, Long Island Lighting Co.; W. H. Aldrich, Aldrich Electric Co.; J. E. Hagedorn, New York Board of Fire Underwriters; H. W. Morrison, Long Island Lighting Co. Standing left to right—K. J. Kenny; John W. Aldrich, Aldrich Electric Co.; A. L. Herbert, Long Island Lighting Co.; Joseph J. Frohnhofer, Frohnhofer Electric Co., Inc., and Nicholas W. Lawrence.

# Now! Real Lighting Flexibility!

**PLEXOLINE** is a new idea—an imaginative engineering creation that permits, for the first time, truly unlimited fluorescent lighting patterns at mass-production costs. **PLEXOLINE** is an ingenious system of related linear sections and circular accent units. Used in combination, these elements are capable of achieving curves, circles, any angular arrangement, rectangles, and straight continuous runs. Used individually, each element is complete in itself.



## DAY-BRITE QUALITY MAKES **Plexoline** PRACTICAL!

The final test of an idea is how well it is carried out. **PLEXOLINE** promises spectacular new flexibility; famous Day-Brite quality *delivers* it . . . your guarantee of matchless year-in, year-out, trouble-free performance and low installation, maintenance and operating costs.

That's **PLEXOLINE** . . . a value-packed combination of versatility and **PREMIUM QUALITY WITHOUT PREMIUM COST** . . . the greatest advancement in fluorescent lighting history!

But you need the full **PLEXOLINE** story to properly judge its amazing advantages to you. Send for your free copy of "**PLEXOLINE—IMAGINATION AT WORK.**" Just fill out coupon and mail . . . **TODAY!**



049

**PREMIUM QUALITY  
WITHOUT PREMIUM COST**



Distributed Nationally By Leading Electrical Wholesalers

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5402 Bulwer Ave., St. Louis 7, Mo.  
In Canada: Amalgamated Electric Corp., Ltd.,  
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Please send me \_\_\_\_\_ copies of your free booklet, "**PLEXOLINE—IMAGINATION AT WORK.**"

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**Paragon**

**MODEL 301  
TIME SWITCHES**

Only \$10.50 List  
and with

**LOWEST NET PRICES  
TO CONTRACTORS**



Paragon top quality, straight "ON and OFF" Time Switches are accurate and dependable for controlling stokers, burners, valves, motors and other equipment where two or four operations per day are required. Industrial type, self-starting motor, 115 volt, 60-cycle, 30 Amp., 3000 Watt capacity. Shock-proof terminal back. SPST and DPST; (230V, or 24V, at slightly higher cost).

SEE YOUR JOBBOR OR  
WRITE FOR CATALOGS

**Paragon**

**ELECTRIC COMPANY**

1614 12th STREET • TWO RIVERS, WISCONSIN

AMERICA'S FOREMOST EXCLUSIVE

MANUFACTURER OF

TIME CONTROL SWITCHES FOR ALL USES



E-M Service Masts are the perfect support for service wires on ranch type houses and low commercial structures that do not provide sufficient ground clearance to comply with National Electrical Code requirements (2322 a. & b. 1947).

E-M Service Masts are neat rugged units that require no guy wires. They look good, are hot galvanized to last a lifetime. Developed in cooperation with utility engineers and electrical contractors.

WRITE FOR BULLETIN 51

**Electrical Manufacturing Co.**

Pole Line Hardware

152 Angell St., BATTLE CREEK, MICH.



**J. H. COATES**, Ebasco Services and **A. Lincoln Bush**, chairman of the board, New York State Electrical Contractors & Dealers, Inc., at Saranac Inn were at Saranac Inn last month.

engineers, 7% general contractors, 9% electrical distributors, 2% utilities and 26% no one. When asked why they bought lighting and the benefits expected, 50% said because it gives better appearance, 10% because they want to make more sales in stores, better displays, 42% said improved working conditions, 73% better illumination and 14% interested in buying lighting because it reduces costs.

Commercial electric cooking was discussed by **Leonard P. Fries**, consulting power engineer, New York State Electric & Gas Corp., Binghamton. Mr. Fries said that in 1939 the market for commercial electric cooking was \$3½ billion and in 1950 it is nearly \$15 billion. Also there are 500,000 prospects in the United States. He urged that the contractors promote cooking by recommending it to customers as safe, cool and economical. And if the customer is not going to install electric cooking at the beginning, he urged the contractors to see that the service and main panel has ample capacity to carry the load when it is needed.

**J. H. Coates**, Ebasco Services, New York, told the utility power sales engineer's story of contractor-utility opportunities for cooperative effort. He cited many examples in Pennsylvania, New Jersey, Ohio, the South and other sections of the country where the electrical contractor has worked with the utility engineer in selling new substations and new distribution facilities to industries in these various communities. In most every case the electrical contractor received contracts in substantial amounts, some amounting to half a million dollars. He also pointed out that in many cases the electrical contractor is now doing all

the work in these plants. He urged that the contractor get acquainted with the utility power salesman in his community and work with him.

On Wednesday evening **Alston Rodgers**, Lamp Department, General Electric Company, Nela Park, Cleveland, put on the "Light Sorcery" show. A motion picture entitled "If you Don't Watch Out" was also shown.

**F. S. Kinsey**, manager, Eastern District Lamp Division, Westinghouse Electric Corp., New York was chairman of the Thursday meeting. **Herbert Metz**, district manager, Graybar Electric Company, Inc., New York spoke on the "Electrical Contractor's Interest in Salesmanship". He pointed out the tremendous markets and opportunities for the electrical contractors to go out and sell electric heating, adequate wiring in homes, lighting, telelath equipment for homes, air conditioning and room coolers. He said that he believes it would be necessary for contractors to employ sales people to do this job.

Heat pumps was discussed by **George Marshall**, engineering products planning division, Air Conditioning Dept., General Electric Company, Bloomfield. He told of the advantages of year round comfort in the home and demonstrated with slides the performance of the heat pump.

**Richard Williams**, deputy inspector of insurance with the State Insurance Fund explained the group compensation insurance under the state insurance law and told why the contractors should belong to the special group of the New York State Association of Electrical Contractors & Dealers in the State Insurance Fund. This plan provides to all employers insurance at the lowest possible cost but only members of the Association are eligible to participate in this group plan.

**E. J. Hegarty** of Westinghouse Electric Company gave an interesting talk on how to be a better salesman.

(Continued on page 136)



**KEPT BUSY** at the convention of the New York State Electrical Contractors & Dealers, Inc., at Saranac Inn were **A. A. Tuna**, New York, president, and **H. F. Janick**, Rochester, secretary.



**USERS SAY**  
**G.E.'S 9574** **ALL-PURPOSE\***  
**INSULATING VARNISH**

**"is tops!"**



J. L. Hughes

How do users like General Electric's new all-purpose insulating varnish G-E 9574?

Here's a statement from J. L. Hughes, owner of the J. L. Hughes Electric Company, Columbus, Ohio.

*"We have found from test and practical experience that General Electric general-purpose varnish 9574 is tops for our work."*

Mr. Hughes knows what he is talking about. He has been in the business of motor repair and rewinding in Columbus for thirty-three years.



**YES, G-E 9574 OFFERS YOU**

**One** varnish you can depend on for ALL\* jobs.

**A Combination** of electrical, chemical and mechanical properties formerly found only in special-purpose varnishes.

**Easier Handling:** Low baking temperature; deep penetration; simple thinning with petroleum spirits.

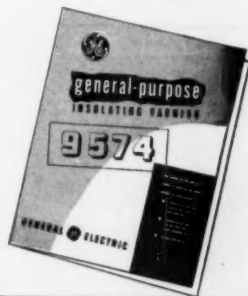
\*G-E 9574 gives excellent results on all types of coils except extra-high-speed armatures. It is one of G. E.'s complete line of electrical insulating materials, including adhesives, wedges, cements, compounds, cords and twines, sleeving, wire enamels, mica, papers and fibers, permafiles, tapes, tubing, varnished cloths, and varnishes.



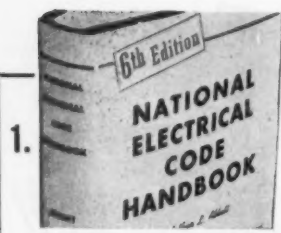
**SEND FOR BULLETIN!** If you haven't yet tried G-E 9574, get in touch with your local G-E Distributor, or write for our new bulletin to Section K1, Chemical Department, General Electric Company, Pittsfield, Massachusetts.

*You can put your confidence in*

**GENERAL  ELECTRIC**







1.

## Now Contains the 1949 supplement to the Code

(Bound-in supplement follows same clear interpretation of Code as rest of Handbook. Book same price with supplement included.)

National Electrical Code Handbook gives rules and requirements of all jobs; what they mean—how to apply them in accordance with the latest National Electrical Code. All rules for a job are grouped in one place. Covers definitions of Code terms and requirements applying to all wiring systems. By A. L. Abbott. 6th Ed., 688 pages, \$5.00.

## 2. The LINEMAN'S HANDBOOK

That transmission line fact you want in this handy guide giving principles, data, methods and cautions on all aspects of the lineman's work. Describes all the materials of line construction; poles, conductors, hardware, tools, electrical apparatus, etc. Information on construction, testing and maintenance shows how to meet problems with right choice of materials and methods. By E. Kurtz. 2nd Ed., 682 pages, \$5.00.

## 3. STANDARD HANDBOOK for Electrical Engineers

An encyclopedia of facts and figures, definitions, conversion factors, physical and mathematical principles, accepted formulas and experimental data. Over 2500 pages give you the combined experience of experts in the field. Includes important new developments . . . radar and associated microwave techniques . . . magnetic materials . . . servomechanisms and rotating regulators . . . induction and dielectric heating . . . airplane power distribution . . . nuclear energy . . . etc. A. E. Knowlton, Editor-in-Chief, 8th Edition, 2311 pages, \$12.00.

## 4. AMERICAN ELECTRICIANS' HANDBOOK

Contains hundreds of detailed descriptions, rules, methods, pictures and practical data to help you install, maintain and operate electrical equipment. Includes recent advances in electronic tubes and circuits and their industrial applications. By T. Croft; revised by C. Carr. 6th Ed., 1734 pages, \$6.00.

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**INTERESTED GROUP** at the convention of the N. Y. State Electrical Contractors & Dealers, Inc. at Saranac Inn was (left) James F. Burns, Schenectady; E. G. May, Albany; Louis Lidsky, Brooklyn; and John Porter, Albany.

At the business meeting on Friday, the following officers were elected for next year: E. G. May, Albany, chairman of the board; A. A. A. Tuna, New York, president, Ray J. Knoblock, Syracuse, first vice president; William L. Drexler, New York, second vice president; James F. Burns, Schenectady, treasurer; H. F. Janick, Rochester, secretary. A. Lincoln Bush, who retired as chairman of the board after serving for 25 years, was appointed chairman emeritus. Harold A. Webster, New York, was elected a director and A. Lincoln Bush and Louis Freund were reelected directors.

## Dates Ahead

**Illuminating Engineering Society**—National Technical Conference, Hotel Huntington, Pasadena, Calif., Aug. 21-24.

**International Association of Electrical Inspectors**—Northwestern Section, Seattle, Wash., Sept. 11-13; Southwestern Section, San Jose, Calif., Sept. 18-20; Eastern Section, Hotel Statler, Buffalo, N. Y., Sept. 25-27; Western Section, Hotel Book Cadillac, Detroit, Mich., Oct. 2-4; and Southern Section, Daytona Beach, Fla., Oct. 16-18.

**International Municipal Signal Assn.**—55th Annual convention, Hotel Commodore, New York, N. Y., Sept. 18-21.

**Canadian Electrical Manufacturers Assn.**—Annual meeting, General Brock Hotel, Niagara Falls, Ont., Sept. 27-29.

**International Association of Electrical Leagues**—Annual Conference, Copley Plaza Hotel, Boston, Mass., Oct. 11-14.

**National Electrical Contractors Association**—Annual convention, Hotel Statler, Baltimore, Los Angeles, Calif., Oct. 17-20.

**National Electrical Manufacturers Association**—Chalfonte-Haddon Hall, Atlantic City, N. J., Nov. 13-16.

**American Standards Association**—Annual Meeting, Waldorf-Astoria Hotel, New York, N. Y., Nov. 27-29.

**American Institute of Electrical Engineers**—Winter General Meeting, New York, N. Y., Jan. 22-26, 1951.

**Illuminating Engineering Society**—New York Section, Northeastern Regional Conference, Hotel Statler, New York, N. Y., October 26-27.

**National Electric Sign Association**—Hotel New Yorker, New York, N. Y., February 5-7.

## Manufacturers News

Albert J. Maslin has recently been appointed assistant to the engineering manager of the Westinghouse Electric Corporation, Transformer Division at Sharon, Pa.

George Skipton, application engineer for the transportation division of Westinghouse Electric Corp. in San Francisco since 1922, has been placed in charge of all company activities having to do with the supplying of electrical apparatus to the city and county of San Francisco.

Joseph H. Cox has been named supervisor of electrical engineering for the Sunnyvale Works of Westinghouse.

W. E. Henges, Cleveland district manager for the Graybar Electric Company has been appointed assistant to the president effective September 1. C. E. Kirkpatrick, manager of the company's Memphis branch will succeed Mr. Henges as Cleveland district manager.

J. W. Horne becomes manager of the Memphis branch, succeeding Mr. Kirkpatrick.

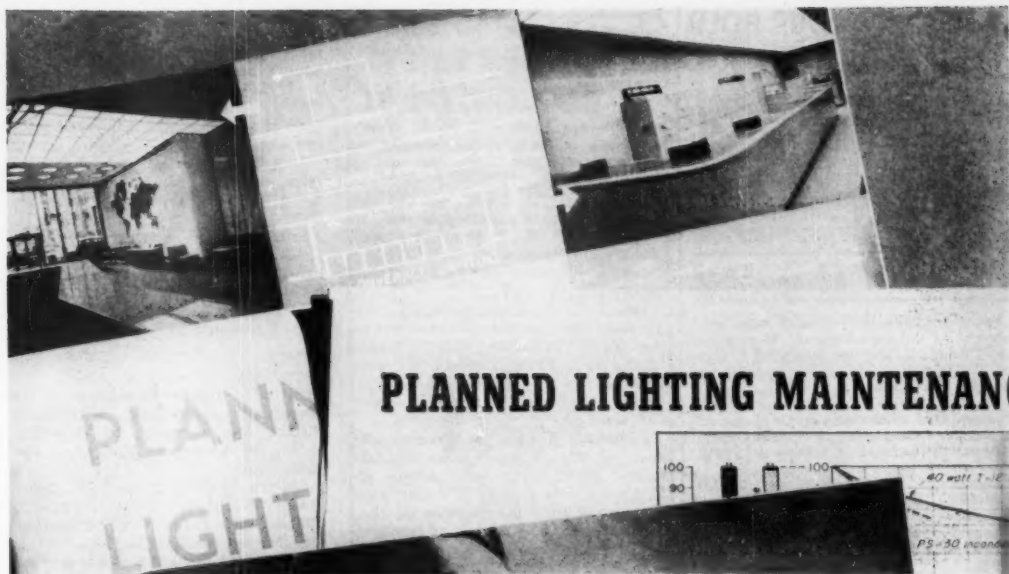
W. J. Goerisch has been named manager, power apparatus sales. The post of manager, lamp sales, vacated by Mr. Goerisch, will be taken over by B. P. Van Inwegen, who was manager, supply specialty sales.

Appointment of Wm. McNulty as manager of the Syracuse branch has been announced.

John L. Bussey, of Bridgeport, Conn., has been elected a vice president of the General Electric Company and placed in charge of marketing policy, a newly-created post. Mr. Bussey has been president and a director of the General Electric Supply Corp.

William V. O'Brien, of Schenectady, N. Y., formerly general sales manager of the apparatus department, has been elected a commercial vice-president and has been appointed assistant manager of marketing policy for the company. Charles R. Pritchard, of Bridgeport, formerly manager of marketing for the appliance and merchandise department, has been elected president and a director of the G-E Supply Corporation. Mr. Bussey and Mr. O'Brien will establish headquarters in New York and Mr. Pritchard in Bridgeport.

Clarence H. Linder, of Schenectady, N. Y., formerly assistant to the general manager of the apparatus department, has been appointed manager of



## Outstanding Lighting Issue

The planning, selling and installing of modern lighting is a mighty important part of your work. Modern lighting means Planned Lighting and includes planned wiring, layout and fixture selection to meet the requirements of each individual job.

The October issue of Electrical Construction and Maintenance will feature a 24-page section designed to help you plan, sell and install more and better lighting.

**Part 1.** An analysis of the lighting market today based on the NEMA-sponsored Indianapolis survey—prepared and pre-

sented so you can evaluate your own local market.

**Part 2.** A series of case studies of actually installed lighting jobs, illustrated, analysed and explained, and covering the following:

Airport Terminal Bldg.	Bank
Home Furnishing Store	School
Office Building	Shoe Store
Auto-Salesroom	Jewelry Store

Many manufacturers will show in this October issue their latest developments in lighting products to help you go after the Planned Lighting market.



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engineering and acting manager of manufacturing of the company's affiliated manufacturing companies' department.

Three new appointments in the small and medium motor divisions has been announced. These are: D. E. Moorhead as administrative assistant to the manager, O. F. Vea as manager of sales, and F. B. Hornby as manager of engineering. They will all be located at the Schenectady Works.

Harrison D. Beale has been named manager of the renewal parts division, industrial divisions of the apparatus department.

George O. Hodgson retired on July 31 from his position of manager of the Rocky Mountain Sales District of the G-E Lamp Department, with headquarters at Denver, Colo. after having completed 41 years of continuous service with the company.

Willard S. Hemker has become manager of the Virginia sales district, Lamp Dept. with headquarters at Richmond, Va. James P. Roger, now manager of the Virginia Sales district, has replaced Mr. Hodgson as manager of the Rocky Mountain sales district.

George E. Burens, of New York, manufacturing manager of the G-E affiliated manufacturing companies' department, has been named acting general manager of Locke Inc., G-E affiliate with headquarters in Baltimore.

American Steel & Wire Company, Cleveland, Ohio, has announced the appointment of Perry T. Coons as assistant to vice president-sales.

H. M. Francis, vice president-sales of the Wire Company, also announced that the wire rope and construction materials division of the company, will be split into two separate sales units. M. E. Capouch was named manager of the construction materials sales division and E. T. Eggers manager of the wire rope sales division.

Wilmer H. Cordes, manager of market development and advertising has been named general staff manager of the company's sales department. He succeeds Paul L. Lindsay, recently appointed Cincinnati district manager of sales.

Thomas M. Camerden, Cincinnati district manager of sales has been named Pittsburgh district manager of sales.

The board of directors of Westinghouse Electric Supply Company, New York, has elected John F. Myers as president to succeed David M. Salsbury. Mr. Salsbury asked several months ago to be relieved of his position so that he could return to the West Coast. Effective July 1, Mr. Salsbury will become vice president in charge of Texas and Pacific Coast operations of the Supply Company with headquarters in San Francisco.

BullDog Electric Products Company, Detroit, has announced the appointment of A. A. Togen as vice president in charge of sales. He succeeds J. J. Mitchell, who will devote his entire attention to assisting the president in administrative and public relations functions.

Leo H. Lipscomb has been named sales manager of BullDog. J. T. Kelly has been appointed eastern division manager, succeeding H. H. Benfield, who recently resigned. Joseph E. Gillen is the new district manager for the Philadelphia territory, succeeding Mr. Kelly. A. L. Burleigh has been appointed Chicago district manager.

As part of the reorganization of its Marketing Department, Trumbull Electric Mfg. Company of Plainville, Conn., has announced three new appointments.

Charles Bangert, Jr. has been named product planning manager; Yale T. Chaney, sales engineering manager of the Eastern region; and Robert C. Wilson, sales engineering manager of the central region.

Trumbull Electric has also announced the sale of its Raymerson Oven business to Jensen Specialties, Inc., of Detroit, Mich. Paul H. Goodell, who was previously associated with Trumbull as manager of Raymerson sales, is now employed by Jensen Specialties.

The Federal Electric Products Company, Newark, N. J. has announced that Walter H. Knapp has been appointed district manager for the Chicago territory, with headquarters at 737 West Jackson Blvd., Chicago.

The Board of Directors of Sylvania Electric Products Inc. has elected H. Ward Zimmer executive vice president of the company. Mr. Zimmer, who has been vice president in charge of operations for the past two and a half years, joined Sylvania in 1919.

A separate small circuit breaker division has been formed by the I-T-E Circuit Breaker Company, Philadelphia, Pa. Frederick G. Schmidt, who has been assistant to the president, has been appointed manager of the unit.

A. L. Smith Iron Company, Chelsea, Mass., has announced the appointment of Hugh M. Nator as vice president in charge of sales, Smithcraft Lighting Division. Herbert K. Nock and Charles A. McKenna are sales manager and assistant sales manager, respectively.

## RADIO INTERFERENCE FROM FLUORESCENT LAMPS

(FROM PAGE 54)

radio, the greater the possibility of such interference.

The solution is to install filters as close as possible to each lamp or fixture, thus reducing line radiation and line feedback at the point of origin. Such filters suppress the radio energy and by-pass it to ground. Two types of filters are employed for this purpose:

1. Capacitor filters are cylindrical in shape and easily mounted in the fixture. They reduce line radiation and feedback approximately 10 to 1, in addition to the suppression already obtained by small condensers in the auxiliary equipment.
- a. For permanent installations where the capacitor case can be grounded, use the delta-connected capacitor in which each section has a capacity of 0.07 microfarads. Such capacitors are one inch in diameter and 2- $\frac{1}{8}$  inches long, and one per fixture or for 8 feet of a channel of cove installation should be used.
- b. For portable lighting equipment (floor and table lamps, etc.) when the frame of the fixture cannot be grounded, a filter with smaller capacitors (two are 0.02 and the other is 0.002 microfarads) is recommended. Such filters are  $\frac{1}{2}$  inches in diameter and 2- $\frac{1}{8}$  inches long.

2. Inductive-capacitive filters resemble fluorescent-lamp ballasts in appearance, and are used when it is necessary to reduce line noise to a very low level. This filter is pan-shaped, having overall dimensions of 1- $\frac{1}{2}$  by 1- $\frac{3}{4}$  by 4- $\frac{1}{4}$  inches. Each inductive-capacitive filter has a current-carrying capacity of 3.5 amperes, enough for two 4-lamp 40-watt fixtures. However, one filter should be used for each 8-foot section of lamps regardless of wattage.

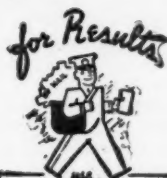
While the interference may be largely caused by a single lamp or fixture of an installation, it is impractical to determine the offending fixture and apply only one filter.

If an FM radio receives a signal of normal strength, special filters will not be necessary for the frequency ranges involved. Television sets getting an adequate incoming signal for normal picture reception will not generally pick up interference from fluorescent lamps.

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METAL, WOOD, PLASTIC**

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You'll make money with a SAW-GUN on the job! The SAW-GUN attaches to any electric or pneumatic drill—or a flexible shaft.

If your jobber hasn't one to show you, write us for immediate delivery.



**ONLY  
\$3875**

**MID-STATES WELDER  
MFG. CO.**

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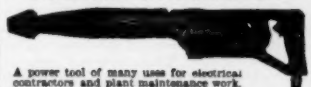
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Shreveport, La.

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Special value . . .**

If you mention this magazine, when writing advertisers. Naturally, the publisher will appreciate it . . . but, more important, it will identify you as one of the men the advertiser wants to reach with this message . . . and help to make possible enlarged future service to you as a reader.

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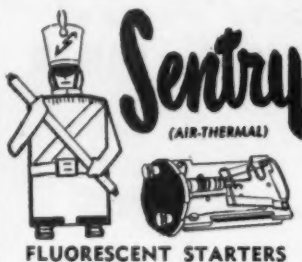


A power tool of many uses for electrical contractors and plant maintenance work. Hammer is detachable from drill member. Drills concrete  $\frac{1}{4}$ " to  $\frac{1}{2}$ " diameter, metal to  $\frac{1}{4}$ " and wood to  $\frac{1}{2}$ ". Forged hammer tools for chipping, channeling and cutting masonry materials. Attachment for right angle drilling.

Ask for BULLETTIN 485-EC

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- Longer lamp life through consistent one cycle starting
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### ADVERTISEMENT

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### . . . of this Buying Information

Mr. Louis A. Ehrlich, Owner of the Superior Electric Co., of Muncie, Indiana, finds the McGRAW-HILL PRE-FILED ELECTRICAL CATALOGS a valuable source of reference in the conduct of his business. In a recent letter, Mr. Ehrlich said: "The new NEMA section in the front of this new Catalog will be used by us many times in the future."

Leading manufacturers pre-filed product information in ELECTRICAL CATALOGS that assists the Catalog user in his selection of reliable sources of electrical equipment and supplies. There is also a comprehensive Directory of Manufacturers, which includes a separate cross-referenced listing of trade names and company addresses. If PRE-FILED ELECTRICAL CATALOGS is not available for buying reference at your plant write to McGRAW-HILL CATALOG SERVICE, 330 West 42nd St., New York 18, N. Y. There is no charge to qualified users.

## CODED RECORDS FOR DISTRIBUTION SYSTEMS

(FROM PAGE 51)

vising circuit tracings in case a motor is changed or removed. Such changes are entered in the equipment records. On the tracings, equipment is identified by name (as an integrated unit).

For every circuit position, a separate information sheet (or group of sheets) is typed directly on some form of stencil or carbon suitable for duplication. Then the required number of copies are made for the record books and the desired cross-files. The sheets are punched for insertion in the loose-leaf record binder. Thus, subsequently revised sheets can easily be placed in proper order and obsolete sheets removed. One, undisturbed master copy of this record can be kept to show the original system details. Other copies can be assigned to responsible personnel to make the necessary up-to-date revisions as changes occur.

The main cross-files are listed under the circuit position designation in the upper right hand corner of the data sheet. Other cross-files were developed using rating or equipment type as the index. For example, one file was made of motors according to horsepower ratings. On one copy of the pertinent data sheet, the rating (horsepower) under motor data was encircled.

Test data recorded on the equipment sheets is as complete as practicable. On the sheet illustrated, phase current, voltage, and motor power factor were noted as of the date the tests were made. In the event detailed analyses of associated systems (piping for pumps, etc.) were made, reference to the engineering reports of such investigations are also noted on the data sheet. Similarly, reference to graphic meter recordings of associated feeders, comprising another report, can also be noted.

Although the equipment sheets shown indicate no electrical maintenance record data, the chief electrician could supplement his copy of the Record Book with standardized maintenance sheets. As for cross-filing, he could use a system most convenient to his needs.

This combined record system has worked well in this large department store. It could be adapted to any electrical system in a commercial or industrial structure and would be particularly advantageous where system alterations and equipment relocation or changes might be frequent.

This form of record system can be adapted to mechanical systems also.

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(Classified Advertising)

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### ELECTRICAL CABLE

- for every industrial and power application.
- Special constructions. Odd lengths.
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- Cut to length. Reasonably priced.

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Large Stock - Reconditioned - Guaranteed Single-Phase, Polyphase and DC — Write for Bulletin.

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1-1500 H.P.

Bought and Sold  
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ELECTRIC EQUIPMENT CO.  
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### GENERATOR SET

Used Fairbanks-Morse 5 cylinder, 176 horsepower @ 770 RPM, with 125KVA Electric Machinery Generator—220-440 volt, 3 phase, 60-cycle. Skid mounted. Only 500 hours, \$10,000.00.  
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"A Unique Tool of the Trade"

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**NO MATTER  
WHAT THE JOB..**

# Auxiliary Power Units are VITAL!



Tracto-Shovel works on Veterinary School of Medicine in Georgia.



Crawler tractor removes debris after disastrous chemical explosion in Texas.



Crawler with Baker bulldozer levels aggregate on new street of Philadelphia subdivision.

Write for **FREE** circular listing hundreds of larger and smaller light plants ranging from 300 watts to 60 KVA. ALL at sensationally low prices and all guaranteed. Also listed are hundreds of other money saving values for YOU.



Crawlers stacking logs on landing near Sandpoint, Idaho.

## Don't pay a premium for power failure insurance COMPARE THESE UNBELIEVABLE PRICES AND BUY NOW.

Regardless of the job or the locale of operation, **AUXILIARY POWER UNITS** are **VITAL** to YOU. Power failures can mean the difference between a profit on the job or just breaking even. Burned out tools due to lack of voltage consumed in long costly cable runs are a thing of the past. **DON'T DELAY**—Mother Nature and aggressive foreign nations operate on an unpredictable schedule—it may be **LATER THAN YOU THINK**. **TODAY** you can buy one of these **BRAND NEW** and guaranteed **WAR SURPLUS** light plants at a fraction of the price you would pay elsewhere. These surplus plants were built by famous big name manufacturers to rigid Government specifications. **YOU ARE BUYING TOP QUALITY.**

Below are **TWO** of the most **SENSATIONAL** light plant buys in the country:

**2500 WATT**  
Formerly \$700.00  
**NOW \$295.00**

2500 WATT, AC, 115 Volt, 60 Cycle, Single Phase. **ENGINE** Briggs & Stratton, air cooled,  $6\frac{1}{2}$  HP **GENERATOR**: Westinghouse or Leland, belt drive with guard and Duplex receptacle mounted. **NET WEIGHT** 310. Gross shipping weight 441. Shipping size 36" x 19" x 26". Complete with \$30.00 worth of spare parts and rubber cable valued at over \$100.00. Tools, instructions and fully **GUARANTEED**. **WAS FORMERLY PRICED AT APPROX. \$700.00.**

**NOW PRICED FOR YOU AT ONLY** ..... **\$295.00 NEW**  
**Reconditioned** ..... **\$225.00**  
**Generator only, NEW** ..... **\$145.00**

**5 KW**  
Formerly \$1400.00  
**NOW \$495.00**

5 KW, 120 Volts, 60 Cycle, AC **ENGINE**: Hercules 4 cycle, Gasoline. **GENERATOR**: Mfr'd. by Hobart Bros. Unit includes remote control cable on reels valued at \$300.00. 150' of 2 wire No. 6 and 150' of 3 wire No. 10, exhaust pipe, power cable plug, remote control stop-start switch, automatic volt regulator. Continuous duty 6.3 KVA at 80% power factor, frequency meter, radio and television interference shield and cannot be damaged by lack of care. net weight 770 lbs. Shipping weight 1070 lbs. 44" long, 23 $\frac{1}{4}$ " wide, 30" high, 220 volt output can be supplied on all units at a small additional cost. **FORMERLY PRICED AT \$1600.00.**

**NOW PRICED FOR YOU AT ONLY** ..... **\$495.00 Guaranteed**

**RURAL:** Farms, Cottages, Tourist Camps, Resorts, Stores, Lumber Camps and Mines.

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**STAND-BY:** Police Radio, Police and Fire Alarm Systems, Radio Telephone, Hospitals, Theatres, Greenhouses, Airports, Cheese Factories, and Dairies.

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DESIGN LEADERSHIP

IN THIS NEW

# Weatherproof FEED-IN DUCT

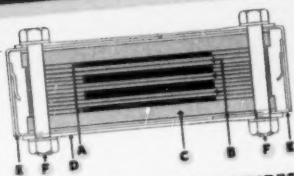


**UNDERWRITERS LABORATORY APPROVED**  
for Weatherproof Installations—Either Horizontal or Vertical Riser Runs. In addition to its complete steel enclosure, this new Weatherproof Duct has all the basic important internal design features of Square D's standard line of Feed-in Duct.

**INCREASED EFFICIENCY.** Temperature rise 50% lower than for other totally enclosed busses of equal copper cross-section and rating. Balanced voltage drop of only 1.8 volts per 100 feet.

**MINIMUM SIZE.** Exclusive design requires no ventilating openings for limiting temperature rise. Permits compact, rigid structure with high resistance to heavy electrical stresses.

**EASILY INSTALLED and MAINTAINED.** Standardized straight sections and fittings. See panel at right.



## EXCLUSIVE DESIGN FEATURES

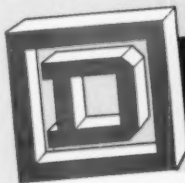
"One-split" bus A with halves positioned on either side of other two busses, permits close spacing and electrical symmetry important to reduction of both energy loss and voltage drop.

Solid ebonized asbestos insulating plates B and C which totally enclose bus, have great mechanical and high dielectric strength, conduct heat readily, are impervious to moisture and resistant to arc.

Surge clamps D and bolts F every 24" give structural and mechanical strength necessary to withstand 50,000 ampere shorts.

Steel housing E completes the weather-proof enclosure.

*Write for Bulletin 5600. Address Square D Company,  
6060 Rivard Street, Detroit 11, Michigan.*



# SQUARE D COMPANY

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SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.



600 Fifth Avenue, New York City

Architects: Carson & Lundin

Mechanical Engineers: Jaros, Baum & Bolles

Electrical Engineers: Smith & Silverman

Builders: Turner Construction Co.

Electrical Contractors: J. Livingston & Co.



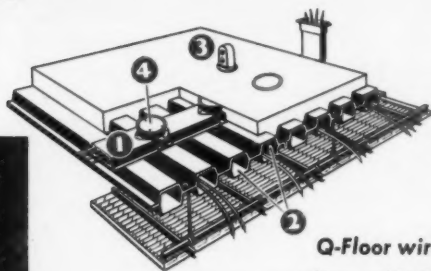
Raceways go in as the Q-Floor is laid, because—with G-E Q-Floor wiring—the floor is the raceway system. Each floor cell is a complete raceway, ready to receive wire, ready for electrical changes any time during the life of the building.

## Planned TODAY for TOMORROW'S Electrical Loads with G-E Q-Floor Wiring

This new building at 600 Fifth Ave., New York City, now under construction by the Massachusetts Mutual Life Insurance Co. is another to join the ever-growing list of modern office buildings which were planned, during the blueprint stage, for future electrical flexibility.


By specifying a General Electric Q-Floor wiring system, provision has been made for increased power loads and unforeseen changes in office layout throughout the entire life of the building. If changes are necessary, tenants won't be disturbed nor vital building facilities disrupted, because the Q-Floor raceway network places additional power or communication outlets within six inches of any point on the floor. To add a new outlet a small hole is drilled through the top of the raceway cell. Then the outlet is wired and set into place—that's all there is to it! Outlets can be removed just as easily when they are no longer needed.

For complete information on wiring installations for new commercial, industrial, or institutional buildings, contact your nearest G-E district office or H. H. Robertson office. Or write to Section C11-818, Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut.



**Q-Floor wiring system**  
offers added electrical flexibility

- 1 Header duct—at right angles to Q-Floor—carries wire from load center to cells.
- 2 Cells serve as raceways for power, signal, and telephone systems.
- 3 Floor outlets are installed by drilling Q-Floor cells at any point.
- 4 Junction units in header duct permit easy access to wiring at any time.

*You can put your confidence in—*  
**GENERAL  ELECTRIC**